Technical Report CERC-96-4
February 1996

US Army Corps of Engineers
Waterways Experiment Station

Redondo Beach, California, 1992-1994 Wave Data

by Margaret A. Sabol

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Prepared for Headquarters, U.S. Army Corps of Engineers

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U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
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Final report

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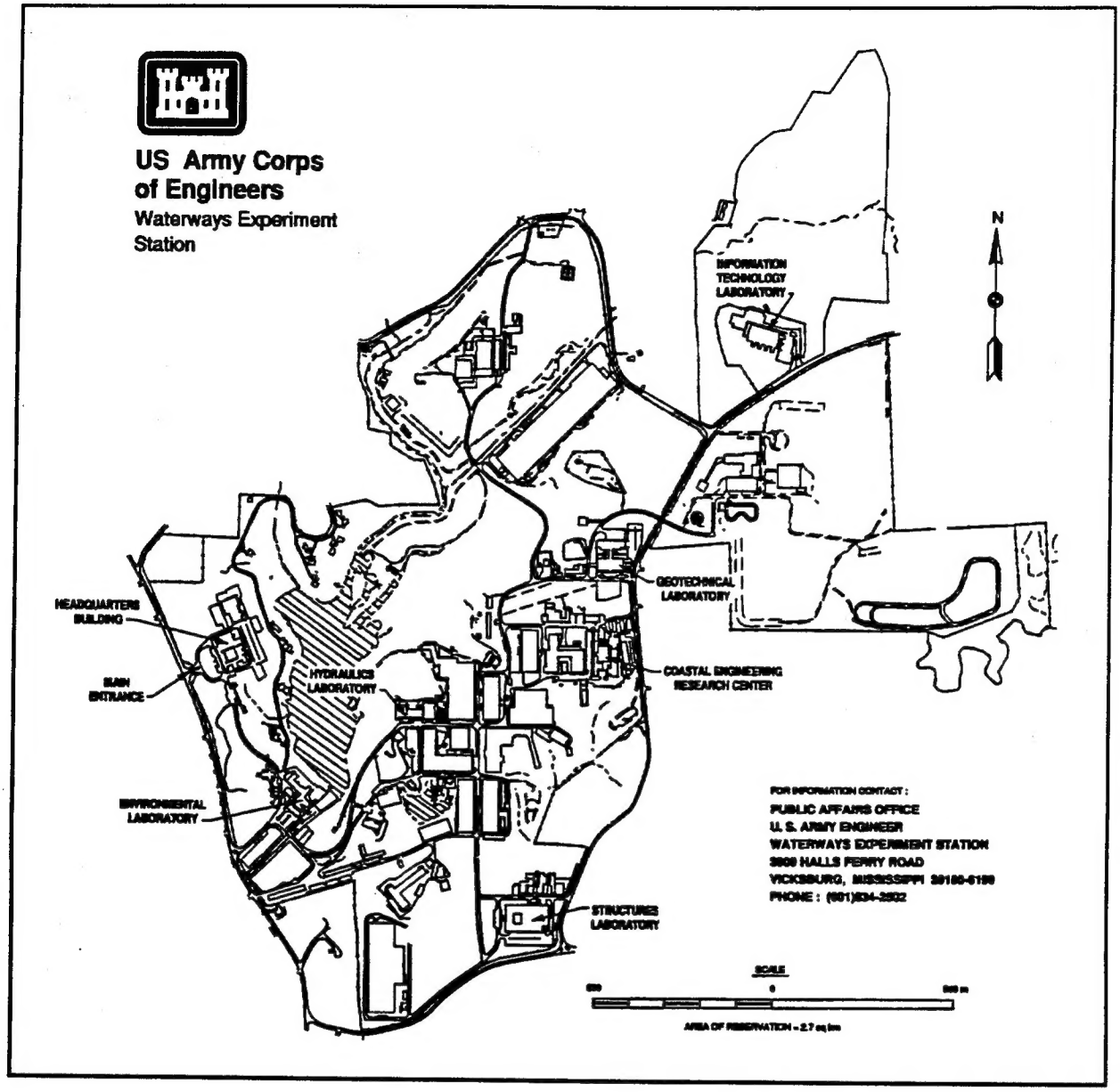

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Preface

This report is a product of the Redondo Beach, CA, Work Unit of the Monitoring Completed Coastal Projects (MCCP) Program, prepared by the Coastal Engineering Research Center (CERC), U.S. Army Engineer Waterways Experiment Station (WES). The MCCP Program Manager is Ms. Carolyn M. Holmes. Technical monitors of the MCCP Program at Headquarters, U.S. Army Corps of Engineers, are Mr. John H. Lockhart, Jr., Mr. Charles Chesnutt, and Mr. Barry W. Holliday. Dr. Thomas E. White, Prototype Measurement and Analysis Branch (PMAB), Engineering Development Division (EDD), CERC, was the former Principal Investigator and Dr. Joon P. Rhee, PMAB, EDD, CERC is the current Principal Investigator.

This report was prepared by Ms. Margaret A. Sabol, PMAB, under the general supervision of Mr. William L. Preslan, Chief, PMAB, and Mr. Thomas W. Richardson, Chief, EDD. Mr. Charles C. Calhoun, Jr. and Dr. James R. Houston are Assistant Director and Director, respectively, of CERC. Director of WES is Dr. Robert W. Whalin, and Commander is COL Bruce K. Howard, EN.

1 Introduction

Background

Field wave data were acquired at Redondo Beach Breakwater, CA, by the Prototype Measurement and Analysis Branch of the U.S. Army Engineer Waterways Experiment Station Coastal Engineering Research Center as part of the Monitoring Completed Coastal Projects Program. This report summarizes data collected throughout the experiment. The purpose of this study was to provide actual field data to evaluate output from a numerical model, Regional Coastal Processes Wave Transformation Model, which predicts waves propagating through a coastal region of irregular bathymetry. This report contains brief descriptions of the monitoring effort and equipment and provides collected wave information in graphic and tabular form. Statistical analysis of wave data will be provided in a future report.

Nearshore Wave Conditions

Nearshore and offshore wave conditions at Redondo Beach, CA, were monitored during a 2-year period beginning October 1992 and ending in June 1994. Nearshore gages were deployed at two separate times during the monitoring period in depths of 14 m - 18 m. The first gages were deployed October 1992 through April 1993 and the second deployment was from October 1993 through June 1994.

Offshore Wave Conditions

Offshore wave conditions were collected from two National Data Buoy Center (NDBC) directional wave buoys. Conditions of waves in intermediate-depth water were provided by NDBC buoy 46045 (Redondo) located in approximately 80 m of water. Deepwater wave data were obtained from NDBC buoy 46025 (Catalina Ridge) at a nominal water depth of 840 m. Locations of the shallow-water gages and NDBC buoys are shown in Table 1 and in Figures 1 and 2.

Table 1
Gage Information

Gage Number	Site Designation	Location
RB6	North	33.860 N 118.412 W
020	North Breakwater	33.848 N 118.406 W
153	South Breakwater (PUV)	33.843 N 118.404 W
RB4A	South Breakwater (DWG-1)	33.842 N 118.404 W
RB5	Canyon	33.830 N 118.399 W
030	Near Breakwater	33.846 N 118.401 W
46045	Redondo	33.839 N 118.447 W
46025	Catalina Ridge	33.747 N 119.068 W

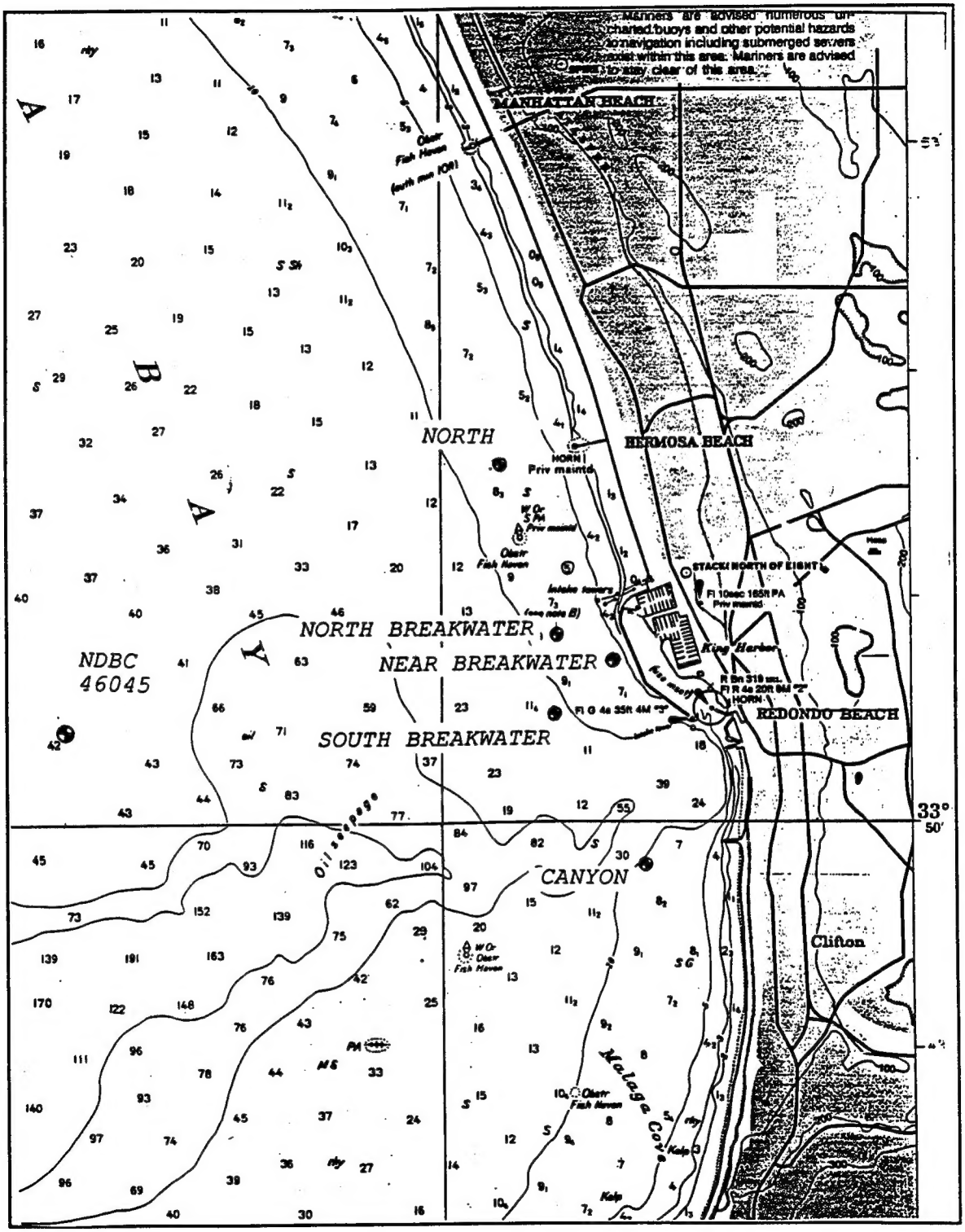

Figure 1. Location of shallow and intermediate-depth gages (soundings in fathoms)

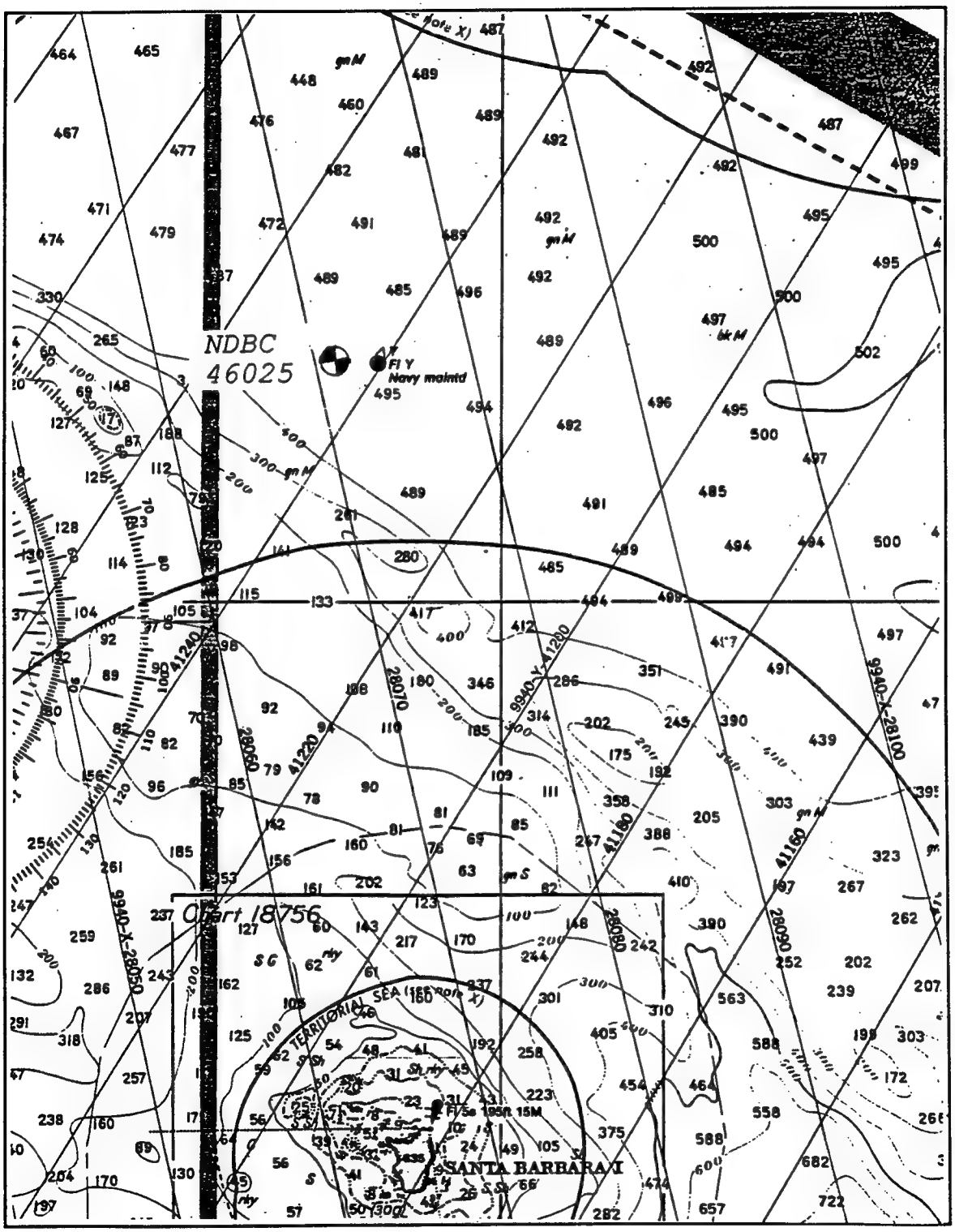

Figure 2. Location of deepwater gage (soundings in fathoms)

2 Nearshore Wave Conditions

Nearshore Gage Description

Nearshore wave conditions were monitored using two different self-recording instruments: directional wave gages (DWG-1) and pressure/U-velocity/V-velocity (PUV) gages. Briefly, a DWG-1 simultaneously measures sea-bottom pressure at three locations, internally processes the data, and records cross-power spectra. The array used is a 1.6-m equilateral triangle with a pressure transducer at each corner. Detailed descriptions of the DWG-1 and comparisons of its performance with other directional wave gages can be found in Howell (1992).[1] A PUV stores simultaneous measurements of three time series, the sea bottom hydrodynamic pressure and the two horizontal cross-axis water-particle velocities. Both DWG-1 and PUV used Paroscientific pressure transducers and the PUVs also used Marsh-McBirney electromagnetic current meters.

Gage Deployment

The first shallow-water gages were deployed in late October 1992 and recovered in mid-April 1993. A total of nine gages were deployed. Gage locations were selected to document variations in wave transformation throughout the area of interest. Site selection was guided by Hales (1987)[2] and U.S. Army Engineer District, Los Angeles (1988)[3]. Gage sites were designated as North (Appendix A), North Breakwater (Appendix B), Near Breakwater (Appendix C), South Breakwater (Appendix D), and Canyon (Appendix E), (see Table 1 for locations). The highest waves due to refraction

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[1] Howell, G. L. (1992). "A new nearshore directional wave gage." *Proceedings, 23rd International Conference on Coastal Engineering, Venice, Italy.* Vol 1, 297-307.

[2] Hales, L. Z. (1987). "Water wave effects at Redondo Beach King Harbor, California," Miscellaneous Paper CERC-87-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

[3] U.S. Army Engineer District, Los Angeles. (1988). "Feasibility report storm damage reduction, Redondo Beach -- King Harbor Area, Los Angeles County, CA." Los Angeles, CA.

would be expected between the North breakwater site (west of the curved portion of the north breakwater) and the South Breakwater site (west of the south end of the north breakwater). The North Breakwater and South Breakwater sites were chosen to monitor this concentrated wave energy. The Canyon site (located near the tip of the Redondo Canyon) was selected to measure wave energy affected by divergence over the submarine canyon. The North site (north of the harbor) was chosen to measure waves at a great distance from the Redondo canyon.

Gages were set out in pairs, with one PUV and one DWG-1 gage at each site except at the Near Breakwater site, where only a PUV gage was deployed. Data were collected from both gage types and the gage type that produced the most data was chosen as the representative data set for that site. All sites with both DWG-1s and PUVs had at least one complete data set. Both NDBC buoys provided a complete data set for the first monitoring period. First deployment data can be found in Tables A1, A2, B1, B2, C1, C2, D1, D2, E1, E2, F1, F2, G1, and G2 and Figures A1-A6, B1-B7, C1-C4, D1-D6, E1-E6, F1-F7, and G1-G7.

The second gage deployment period was from mid-October 1993 through early June 1994. A pair of gages was installed at the South Breakwater site and single gages were installed at the North, North Breakwater, and Canyon sites. NDBC buoys 46045 and 46025 also provided data for most of the deployment period. Data from both NDBC buoys as well as from the South Breakwater and North Breakwater sites are provided to illustrate wave conditions during the second deployment period. Second deployment data are displayed in Tables H1, H2, I1, I2, J1, J2, K1, and K2 and Figures H1, H2, I1-I9, J1-J10, and K1-K6.

Data were obtained from both NDBC buoys during the entire 2-year period (October 1992 - September 1994). Time series plots of data not coincident with deployment of shallow-water gages may be found in Appendix L.

3 Data Summary Products

Description of Parameters

The standard parameters reported in this document are wave height, period, and direction. These parameters are derived from a two-dimensional power density spectrum of the sea surface using spectral analysis of the sensors' output and linear wave theory. The parameters are defined as follows (see the *Shore Protection Manual*[1] for additional information):

a. Wave Height, H_{m0}: Spectrally derived wave height, in meters; equivalent to time-domain-derived significant wave height in deep water.

b. Wave period T_p: Peak spectral period, in seconds; inverse of the frequency of the peak (highest energy) of the one-dimensional power spectrum.

c. Wave Direction, D_p: Peak spectral direction, in degrees clockwise from true North; mean direction *from which* energy is coming at the peak of the one-dimensional power spectrum.

Missing data and data that failed to pass quality control tests are excluded from the summaries.

Description of Products

The following five types of data summary products are provided in this report:

a. Time series plots.

b. Mean/max tables.

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[1] *Shore Protection Manual.* (1984). 4th Ed., 2 Vols., U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center, U.S. Government Printing Office, Washington, DC.

c. Percent occurrence tables.

d. Wave rose plots.

e. Sample spectral density plots.

Descriptions and examples of products are presented in the following sections of the report.

Time Series Plots

Time series plots included in this report indicate wave information collected for each gage and buoy. The plots consist of three separate sets of axes showing H_{m0}, T_p, and D_p for a calendar month. Different gage types collected wave data on different time schedules. The DWG-1s and NDBC buoys collected data hourly. The PUV gages collected data every 3 hr. The plots of H_{m0} and T_p show these individual readings connected by a continuous line. The lines are continuous as long as the data were received at the expected time intervals. The line appears broken if there is one or more missed data point. For H_{m0} and T_p, isolated points of data appear as individual symbols. The plot of D_p shows individual readings designated with a plus (+) symbol instead of a continuous line.

Time series plots of NDBC data show an H_{m0} cutoff of 0.15 m and a T_p cutoff of 2.78 sec. This means that if the H_{m0} is less than 0.15 m, no T_p or D_p will be reported. When the T_p is less than 2.78 sec, no D_p will be reported. These limitations are imposed by NDBC.

Mean/Max Tables

The mean/max tables indicate mean and maximum H_{m0} by month for the monitoring period. A mean H_{m0} is included. Other statistics listed in this table are mean T_p (in seconds); center of most frequent 22.5-deg direction band for directional gages (in degrees azimuth); standard deviation of H_{m0} and T_p; and largest H_{m0} along with its associated T_p, D_p, and the date of the occurrence.

The mean/max table for Gage RB6, North Site (Table A1) indicates that while the largest mean H_{m0}, 1.2 m, occurred in February 1993, the largest H_{m0}, 2.7 m, occurred on March 1993 at 600 hr Universal Coordinated Time (UTC), with an associated T_p of 8.0 sec and D_p of 260 deg.

Percent Occurrence Tables

Percent occurrence tables indicate the percent (times 100) of the total number of wave records for a given site that have a specified H_{m0} and T_p. Tables that depict the heights and period occurrences irrespective of direction are provided for all wave gage stations. Each listed percent value reflects the percent occurrence of waves at a particular H_{m0} and T_p compared to all waves for which H_{m0} was computed. For nearshore gages, height bands are 0.5-m increments; period bands are ten uneven increments from below 4.5 sec to above 18.4 sec (Table 2). Offshore gages have height bands in 1-m increments (to account for larger waves found offshore) with ten period bands at

Table 2
Frequency Ranges Used In Nearshore Data Analysis

Midband		Band Range for Period, sec	Grouping for Percent Occurrence Tables, sec
Frequency, Hz	Period, sec		
0.320	3.1	3.0 ≤ Tp < 3.1	
.	.	.	3.0 - 4.5
.	.	.	
.	.	.	
0.222	4.5	4.4 ≤ Tp < 4.6	
0.213	4.7	4.6 ≤ Tp < 4.8	
0.203	4.9	4.8 ≤ Tp < 4.9	
0.200	5.0	4.9 ≤ Tp < 5.1	4.6 - 5.6
0.187	5.3	5.1 ≤ Tp < 5.4	
0.182	5.5	5.4 ≤ Tp < 5.6	
0.175	5.7	5.6 ≤ Tp < 5.8	
0.167	6.0	5.8 ≤ Tp < 6.1	
0.161	6.2	6.1 ≤ Tp < 6.4	
0.152	6.6	6.4 ≤ Tp < 6.8	5.6 - 8.0
0.143	7.0	6.8 ≤ Tp < 7.1	
0.137	7.3	7.1 ≤ Tp < 7.5	
0.128	7.8	7.5 ≤ Tp < 8.0	
0.120	8.3	8.0 ≤ Tp < 8.6	
0.111	9.0	8.6 ≤ Tp < 9.2	8.0 - 10.6
0.105	9.5	9.2 ≤ Tp < 9.8	
0.097	10.3	9.8 ≤ Tp < 10.6	
0.091	11.0	10.6 ≤ Tp < 11.6	10.6 - 11.6
0.082	12.2	11.6 ≤ Tp < 12.7	11.6 - 12.7
0.074	13.6	12.7 ≤ Tp < 14.1	12.8 - 14.1
0.066	15.1	14.1 ≤ Tp < 15.9	14.2 - 15.9
0.058	17.1	16.0 ≤ Tp < 18.3	16.0 - 18.3
0.050	19.8	18.4 ≤ Tp < 21.3	
.	.	.	18.4 - longer
.	.	.	
.	.	.	
0.027	36.4	32.0 ≤ Tp < 40.9	

uneven increments from below 6.9 sec to above 18.2 sec (Table 3). Totals of the height category are provided at the right of each height row. Totals for each period range are at the bottom of each period column. Results are in summary form at the bottom of the tables showing the mean H_{m0} and T_p, the largest H_{m0}, and the total number of cases represented by the table.

Table 3
Frequency Ranges Used In Offshore Data Analysis

Midband		Band Range for Period, sec	Grouping for Percent Occurrence Tables, sec
Frequency, Hz	Period, sec		
0.400	2.5	2.22 ≤ Tp < 2.86	
.	.	.	
.	.	.	<6.9
.	.	.	
0.160	4.5	6.06 ≤ Tp < 6.45	
0.150	6.7	6.45 ≤ Tp < 6.90	
0.140	7.1	6.90 ≤ Tp < 7.41	6.9 - 8.0
0.130	7.7	7.41 ≤ Tp < 8.00	
0.120	8.3	8.00 ≤ Tp < 8.70	8.1 - 8.7
0.110	9.1	8.70 ≤ Tp < 9.52	8.8 - 9.5
0.100	10.0	9.52 ≤ Tp < 10.53	9.6 - 10.5
0.090	11.1	10.53 ≤ Tp < 11.76	10.6 - 11.7
0.080	12.5	11.76 ≤ Tp < 13.33	11.8 - 13.3
0.070	14.3	13.33 ≤ Tp < 15.38	13.4 - 15.3
0.060	16.7	15.38 ≤ Tp < 18.18	15.4 - 18.1
0.050	20.0	18.18 ≤ Tp < 22.22	
0.040	25.0	22.22 ≤ Tp < 28.57	18.2 - longer
0.030	33.3	28.57 ≤ Tp < 40.00	

In order to determine what percent of the wave records from Gage 030, Near Breakwater, have an H_{m0} of 2.0 - 2.4 m with a T_p of 5.6 - 8.0 sec, the percent occurrence table for that station (Table C2) is consulted. The value 34 is found where the 2.0- to 2.4-m height row intersects with the 5.6- to 8.0-sec period column. Divide this number by 100 to get the percent. Thus, 5.6- to 8-sec waves from 2 to 2.4 m would be expected only about 0.34 percent of the time.

Wave Rose Diagrams

The wave rose diagrams indicate mean H_{m0} and the compass direction from which the waves are coming. The scale of the rose is set so the outer edge

will be slightly larger than the largest mean wave height for the given wave gage station. Three evenly spaced concentric circles within the rose delineate lesser mean wave heights. The value indicated by each circle is differentiated through the use of a distinct line type. Wave directions are grouped in 22.5-deg bands centered on 0, 22.5, 45 deg, etc. Mean H_{m0} and percent of samples for each direction band are represented in the wedge-shaped portions of the rose plots. The length (or radius) of the wedge describes the mean H_{m0}, while the shading of the wedge tells what percent of the samples come from that direction. Only data records that have both D_p and H_{m0} are used in developing the wave roses.

The wave rose diagram for Gage RB5, Canyon (Figure E6), indicates a mean H_{m0} of 0.92 m for the azimuth band centered on 270 deg; and for this time interval, more than 15 percent of the D_p values are within the 270-deg azimuth band. This wave rose diagram also tells at a glance that no waves of any size occurred from the south through the southeast.

Spectral Density Plots

Because of their bulk, all of the spectral data cannot be included in this report. Characteristic spectra are shown in Figure 3. The example provided illustrates characteristic long-period swell propagation from deep to shallow water. The three-dimensional axes show frequency (Hertz) on the x axis, elapsed time (hours) on the y axis and energy density (m^2/Hz) on the z axis. Plots show spectral density for the deepwater NDBC buoy (46025) (North Breakwater site and Canyon site) for the period 1-10 February 1993.

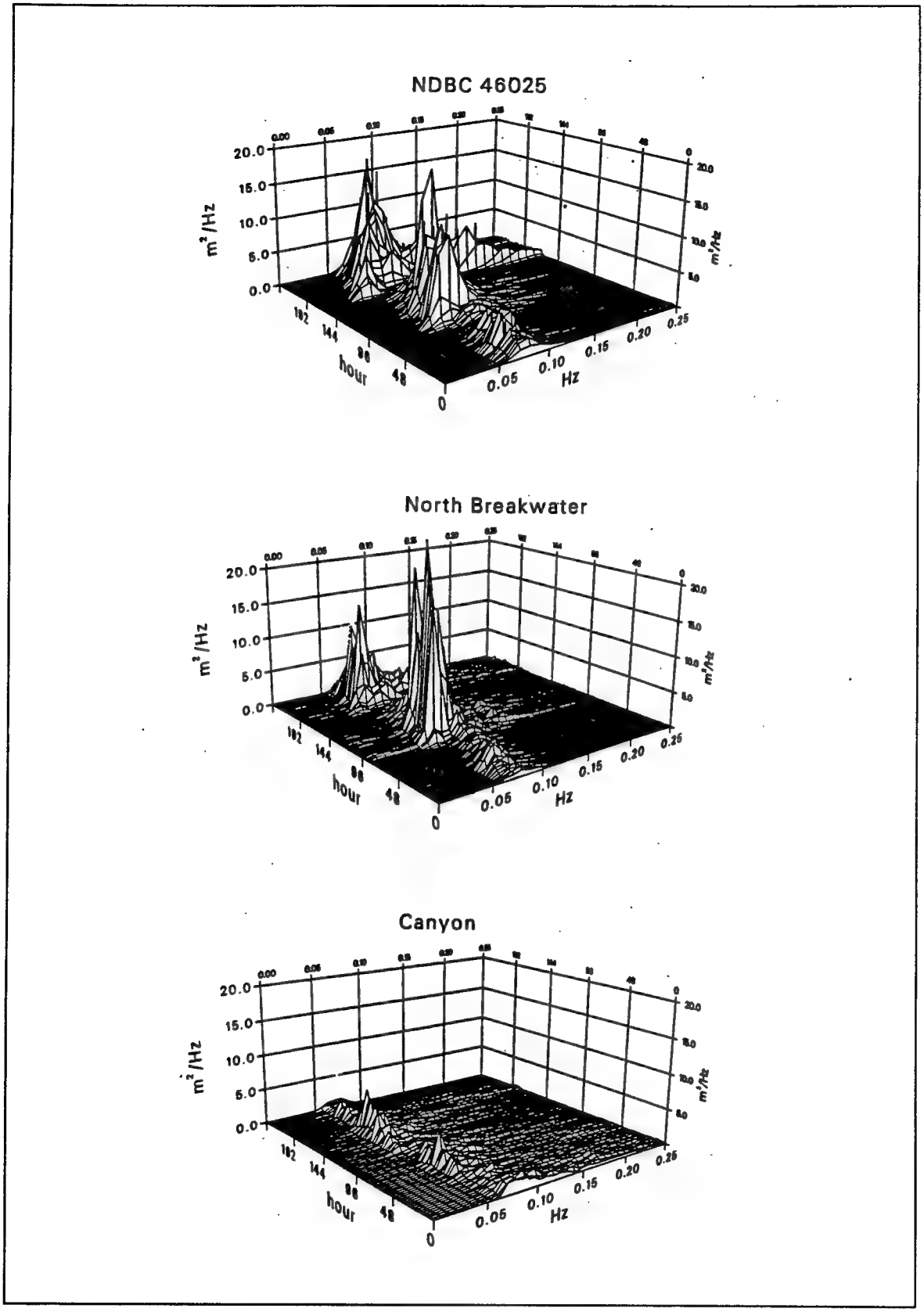

Figure 3. Example swell spectra, 1-10 February 1993

Appendix A
North Site, First Deployment

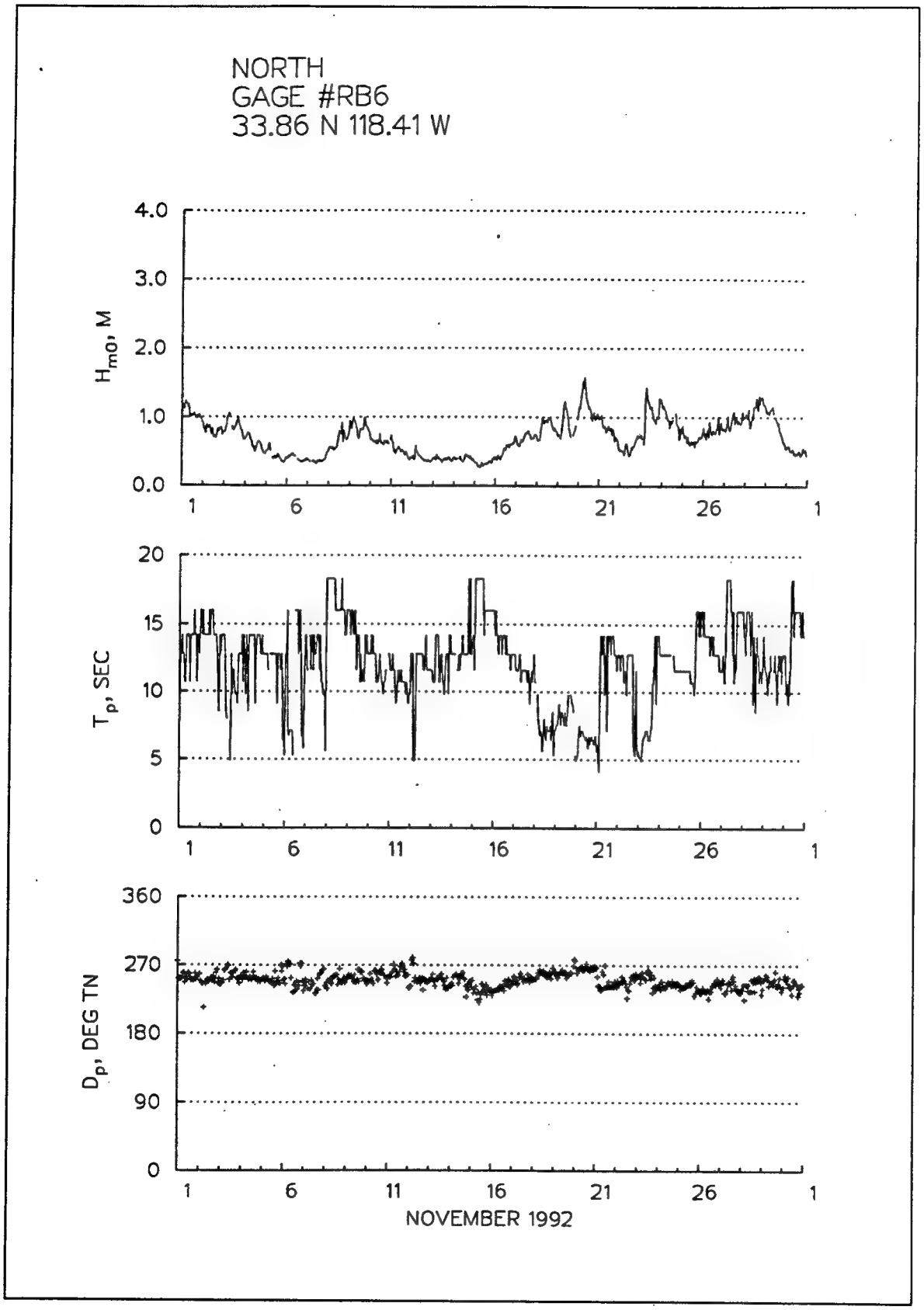

Figure A1. Time series plot for North (gage RB6), November 1992, first deployment

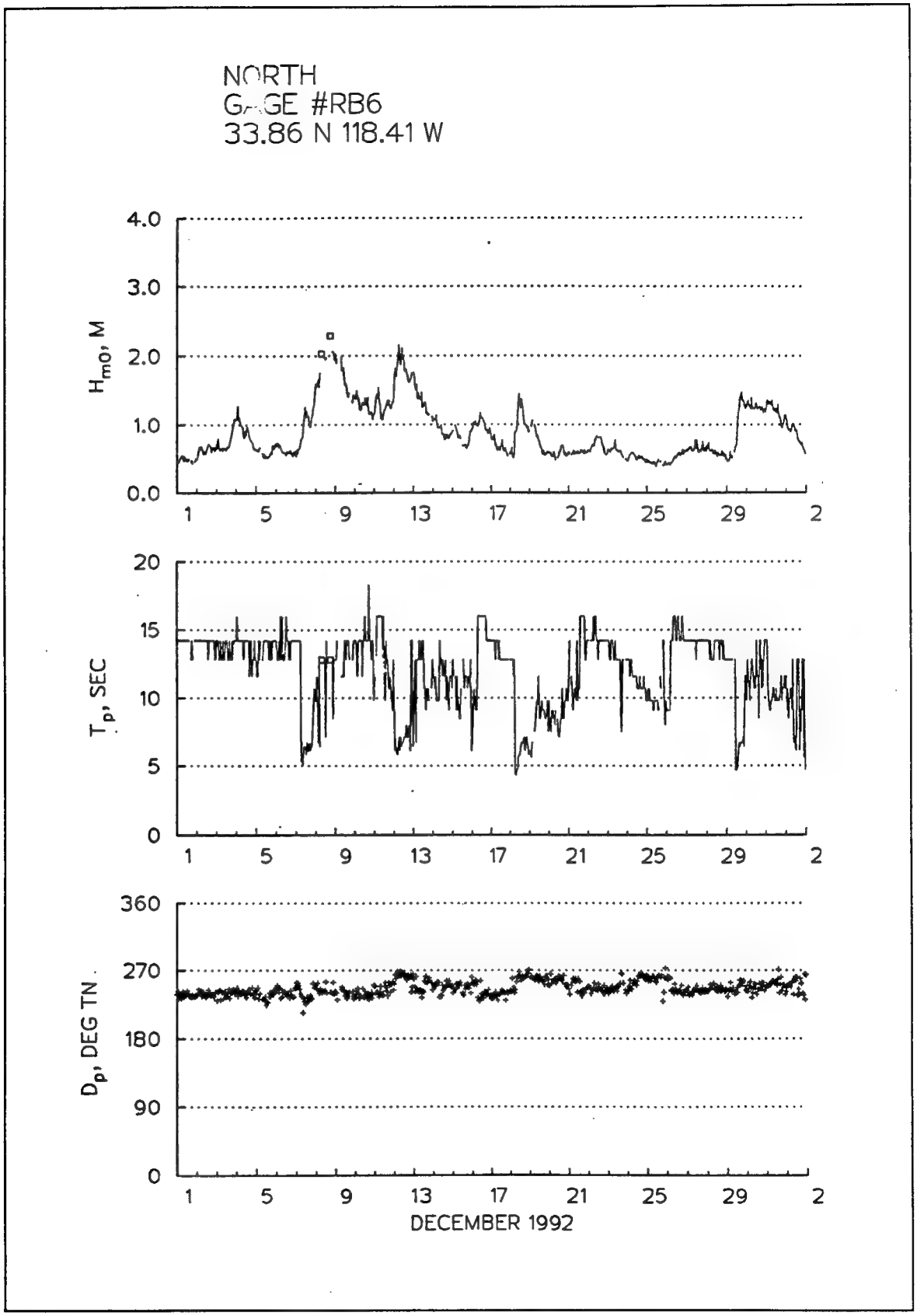

Figure A2. Time series plot for North (RB6) gage, December 1992, first deployment

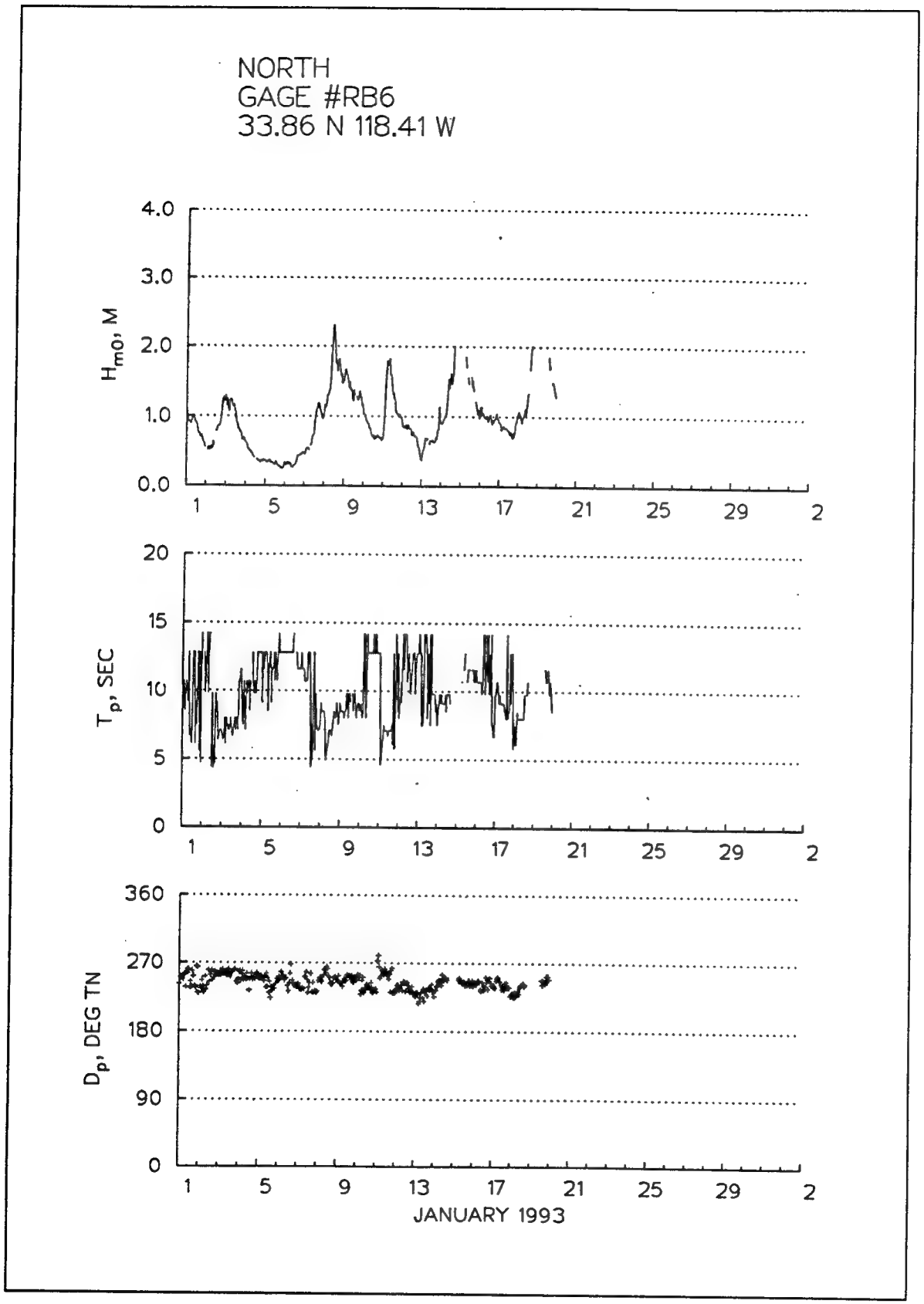

Figure A3. Time series plot for North (RB6) gage, January 1993, first deployment

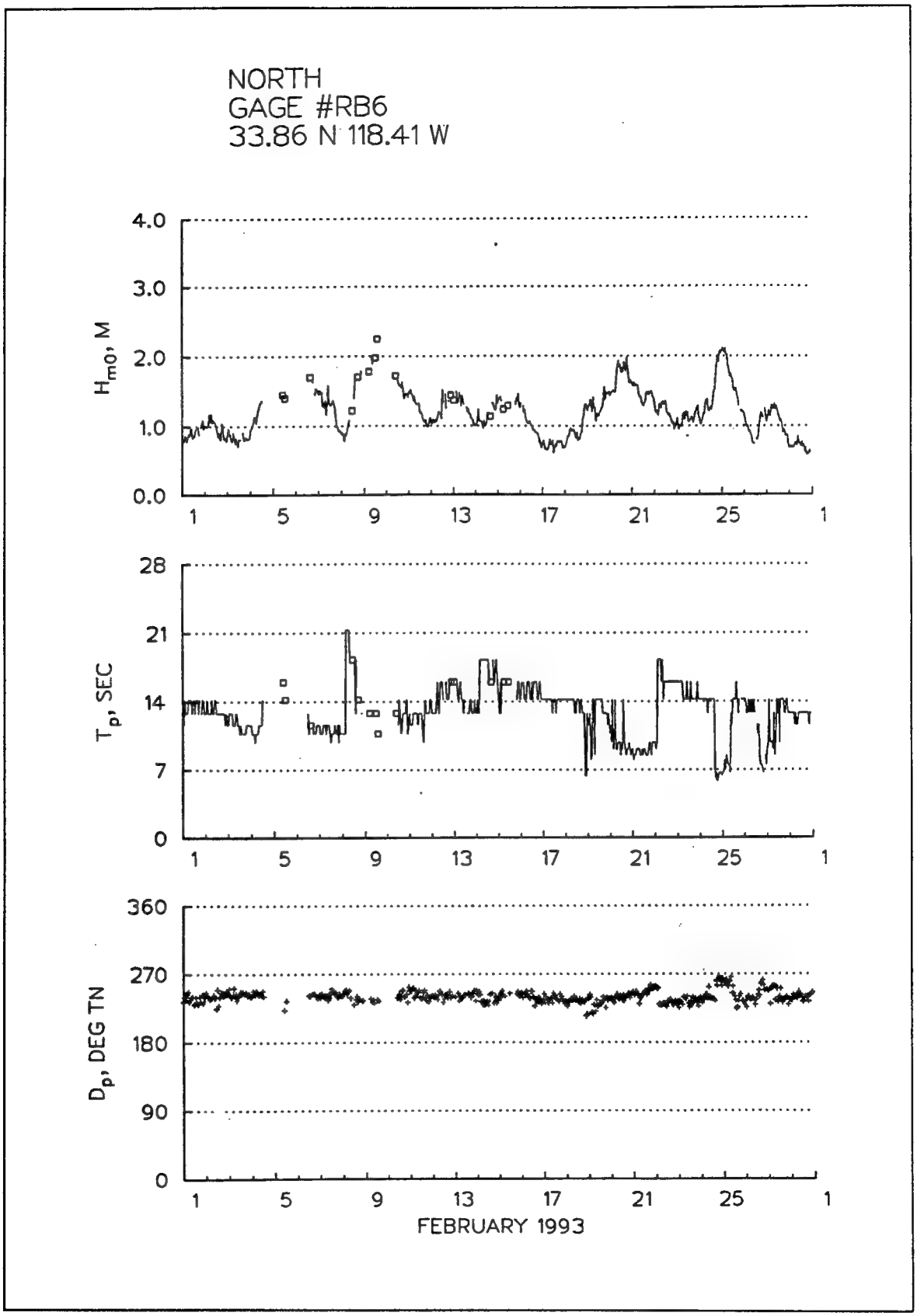

Figure A4. Time series plot for North (RB6) gage, February 1993, first deployment

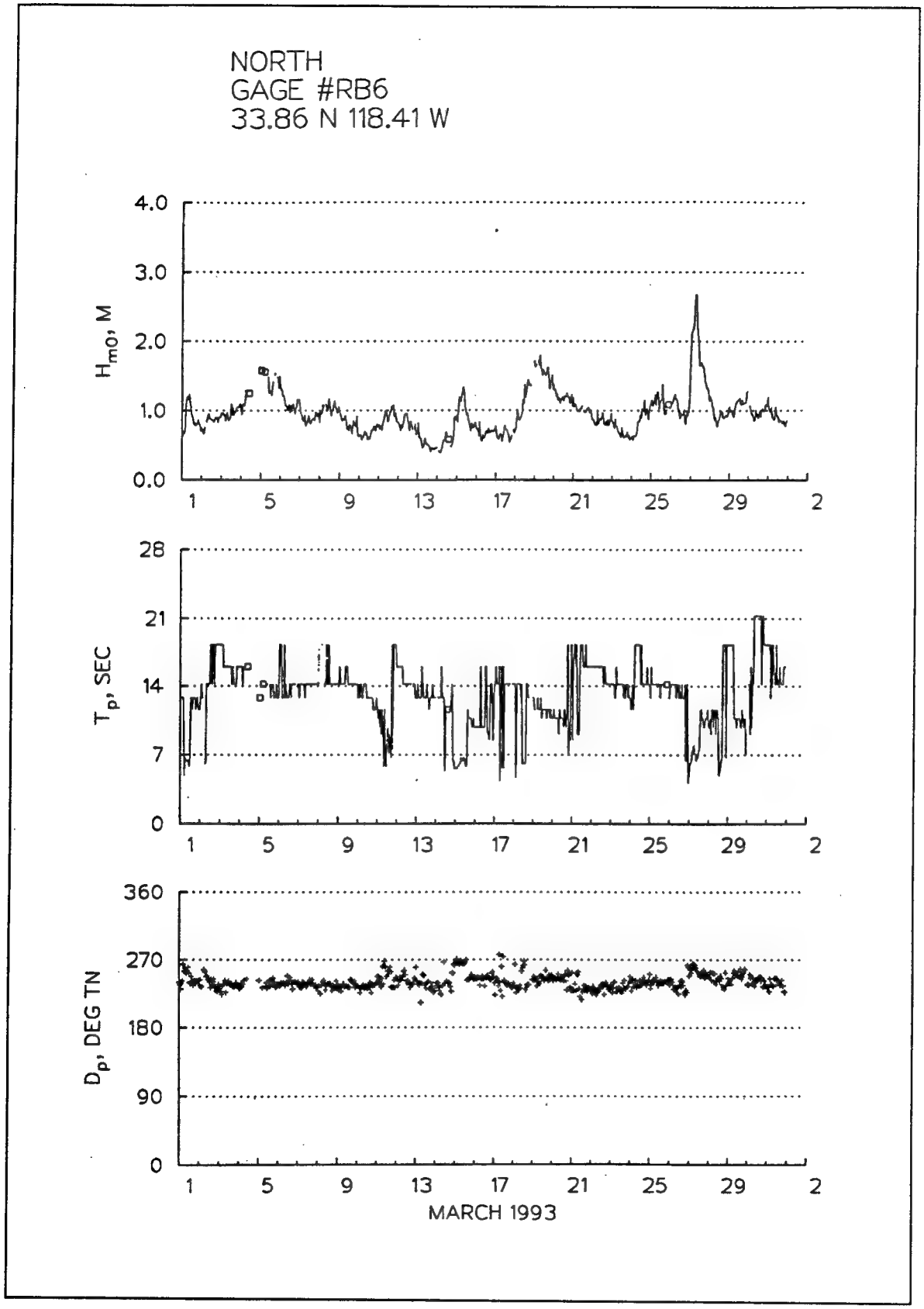

Figure A5. Time series plot for North (RB6) gage, March 1993, first deployment

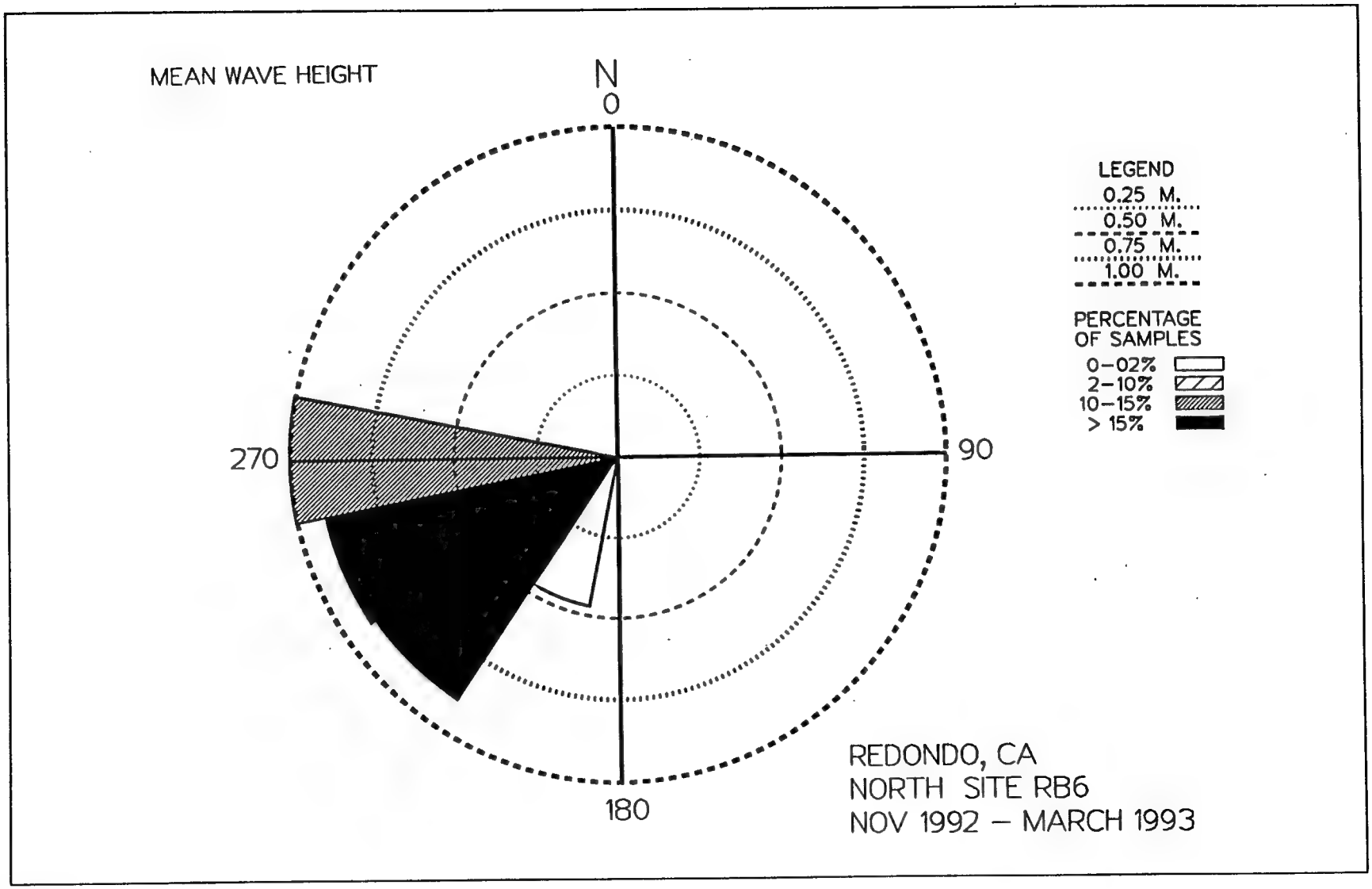

Figure A6. Wave rose for North (RB6) gage, first deployment

Table A1
Mean/Max Values for North (RB6)
First Deployment

MEAN Hm0(meters) BY MONTH AND YEAR
NORTH (33.86N 118.41W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	.	0.7	0.9	0.8
1993	0.9	1.2	1.0	.	.	.	.	.	.	.	.	.	1.0
MEAN	0.9	1.2	1.0	.	.	.	.	.	.	.	0.7	0.9	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NORTH (33.86N 118.41W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	.	1.6	2.3
1993	2.3	2.3	2.7	.	.	.	.	.	.	.	.	.

STATISTICS FOR NORTH (33.86N 118.41W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.9
THE MEAN PEAK WAVE PERIOD (SECONDS)=	12.2
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	247.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	3.1
THE LARGEST Hm0(METERS)=	2.7
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	8.0
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	260.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93032706

Table A2
Percent Occurrence for North (RB6)
First Deployment

NORTH 33.86N 118.41W IRRESPECTIVE OF DIRECTION

NOVEMBER 1992 - MARCH 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	.	9	38	142	87	161	417	171	97	.	1122
0.5-0.9	19	71	372	575	300	491	1132	1643	436	35	5074
1.0-1.4	6	38	427	494	287	213	452	744	333	48	3042
1.5-1.9	.	6	139	161	42	109	100	58	9	.	624
2.0-2.4	.	.	67	16	6	.	19	.	.	.	108
2.5-2.9	.	.	6	3	.	.	.	.	.	.	9
3.0-3.4	.	.	.	.	.	.	.	.	.	.	0
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	25	124	1049	1391	722	974	2120	2616	875	83	

MEAN Hm0(M)= 0.9 LARGEST Hm0(M)= 2.7 MEAN TP(SEC)= 12.2 TOTAL CASES= 3091.

Appendix B
North Breakwater Site, First Deployment

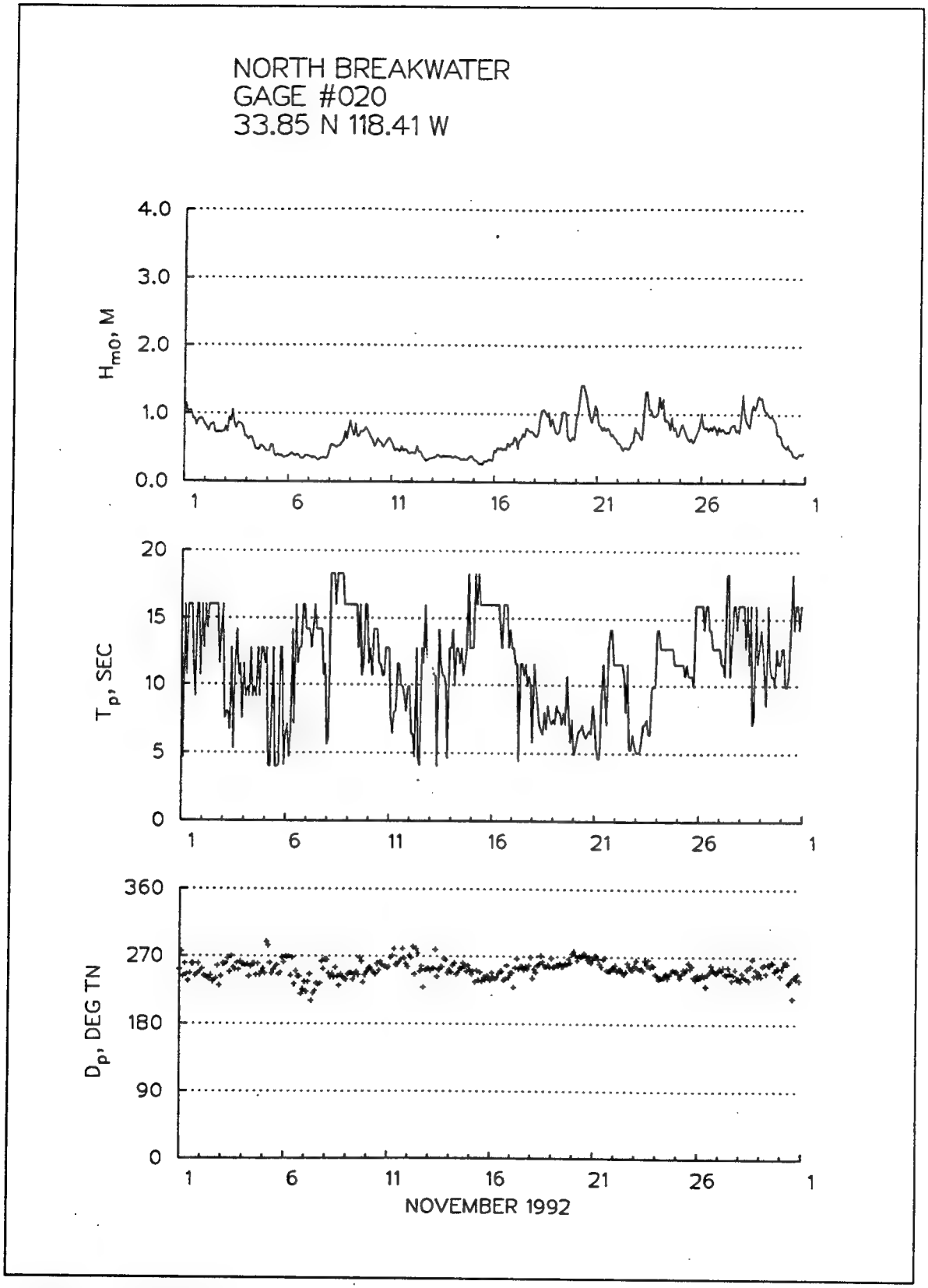

Figure B1. Time series plot for North Breakwater gage (020), November 1992, first deployment

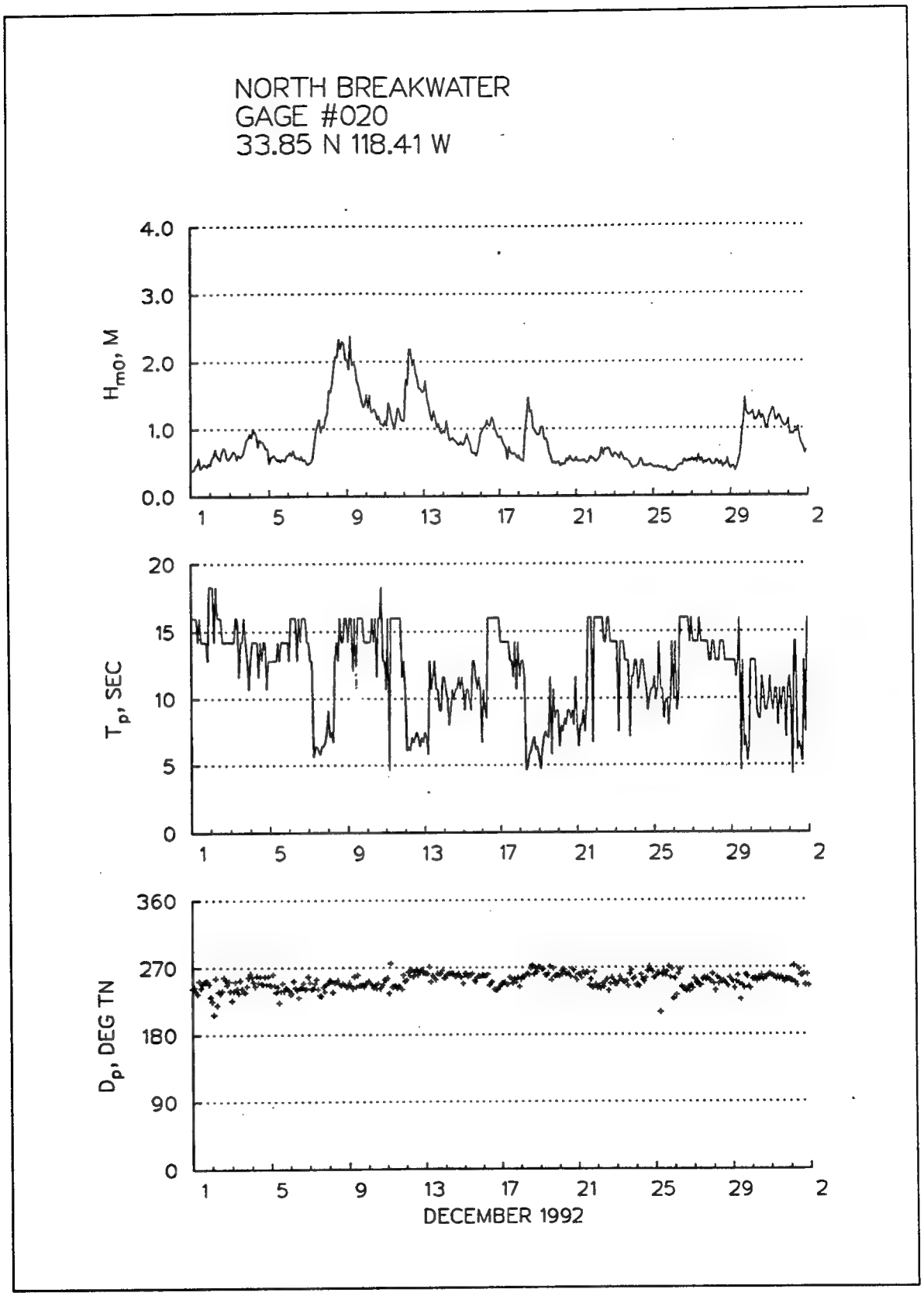

Figure B2. Time series plot for North Breakwater gage (020), December 1992, first deployment

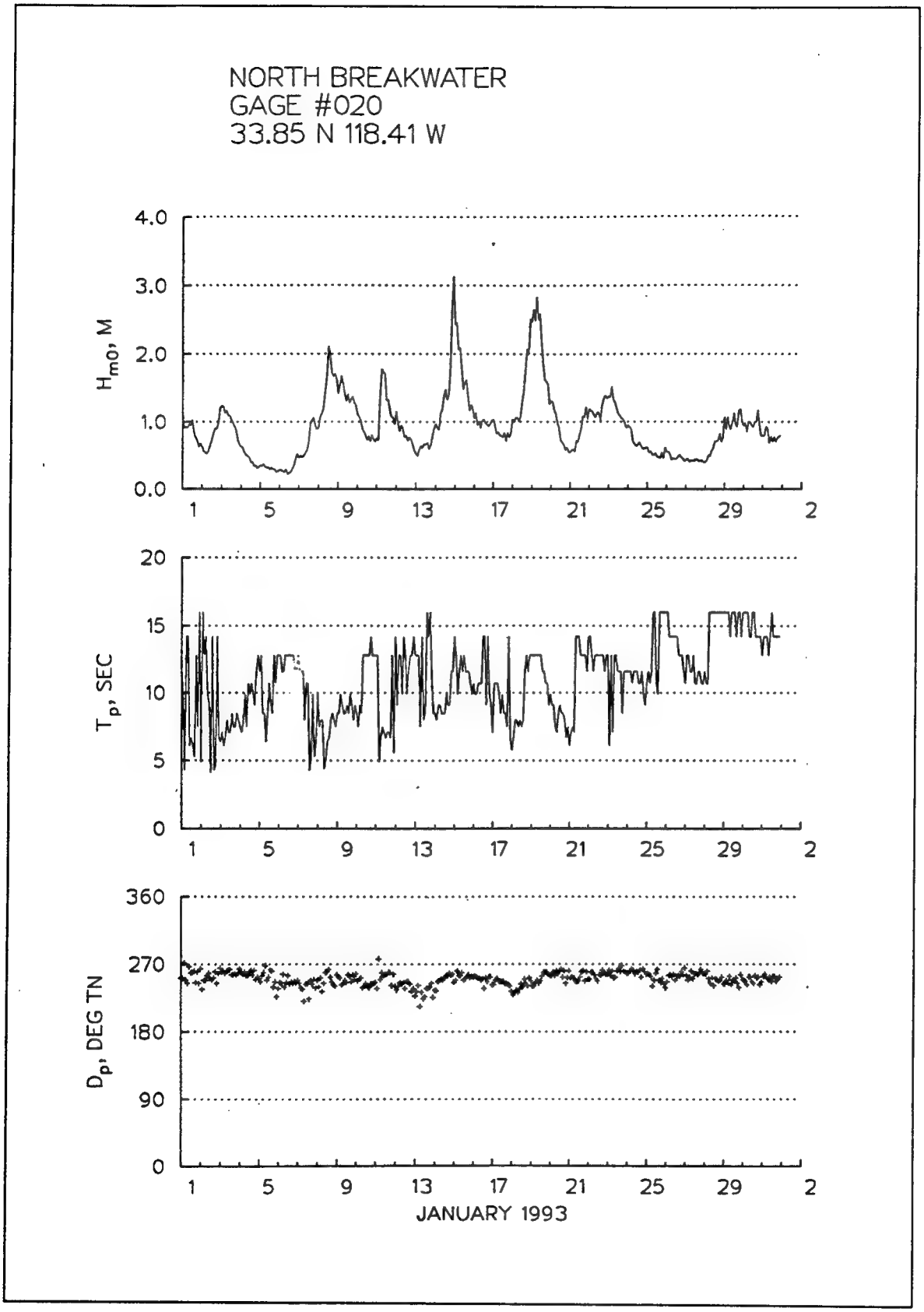

Figure B3. Time series plot for North Breakwater gage (020), January 1993, first deployment

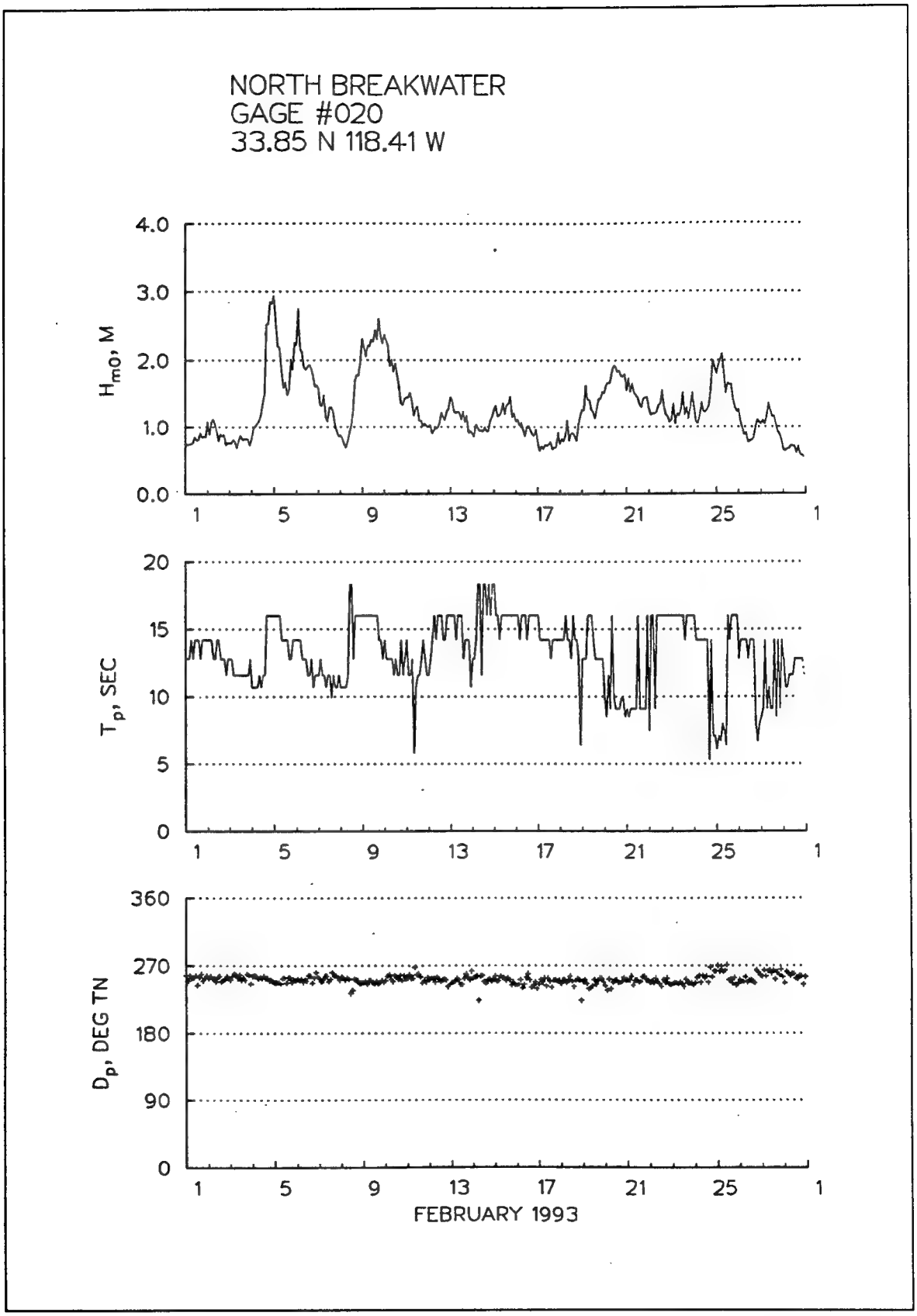

Figure B4. Time series plot for North Breakwater gage (020), February 1993, first deployment

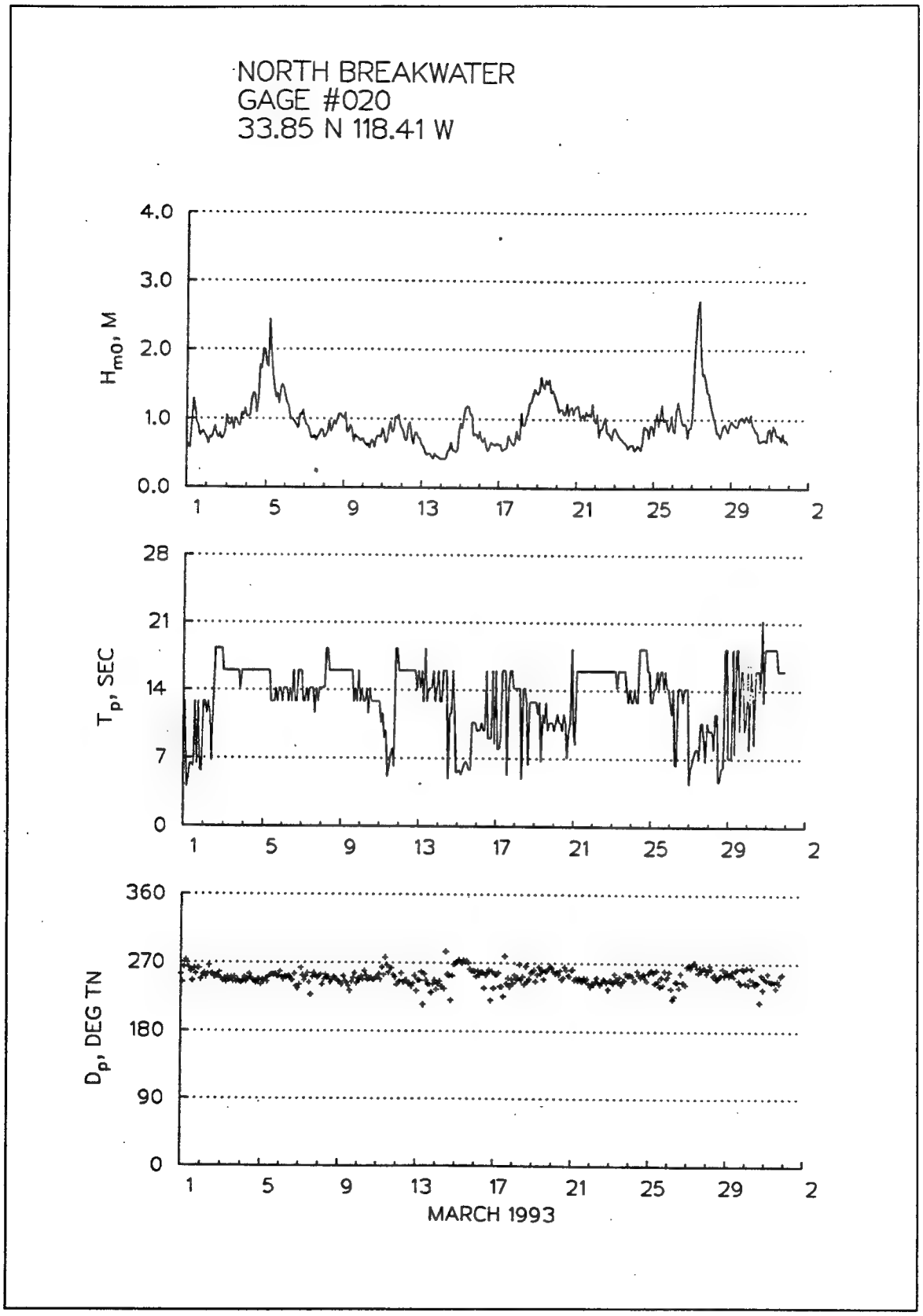

Figure B5. Time series plot for North Breakwater gage (020), March 1993, first deployment

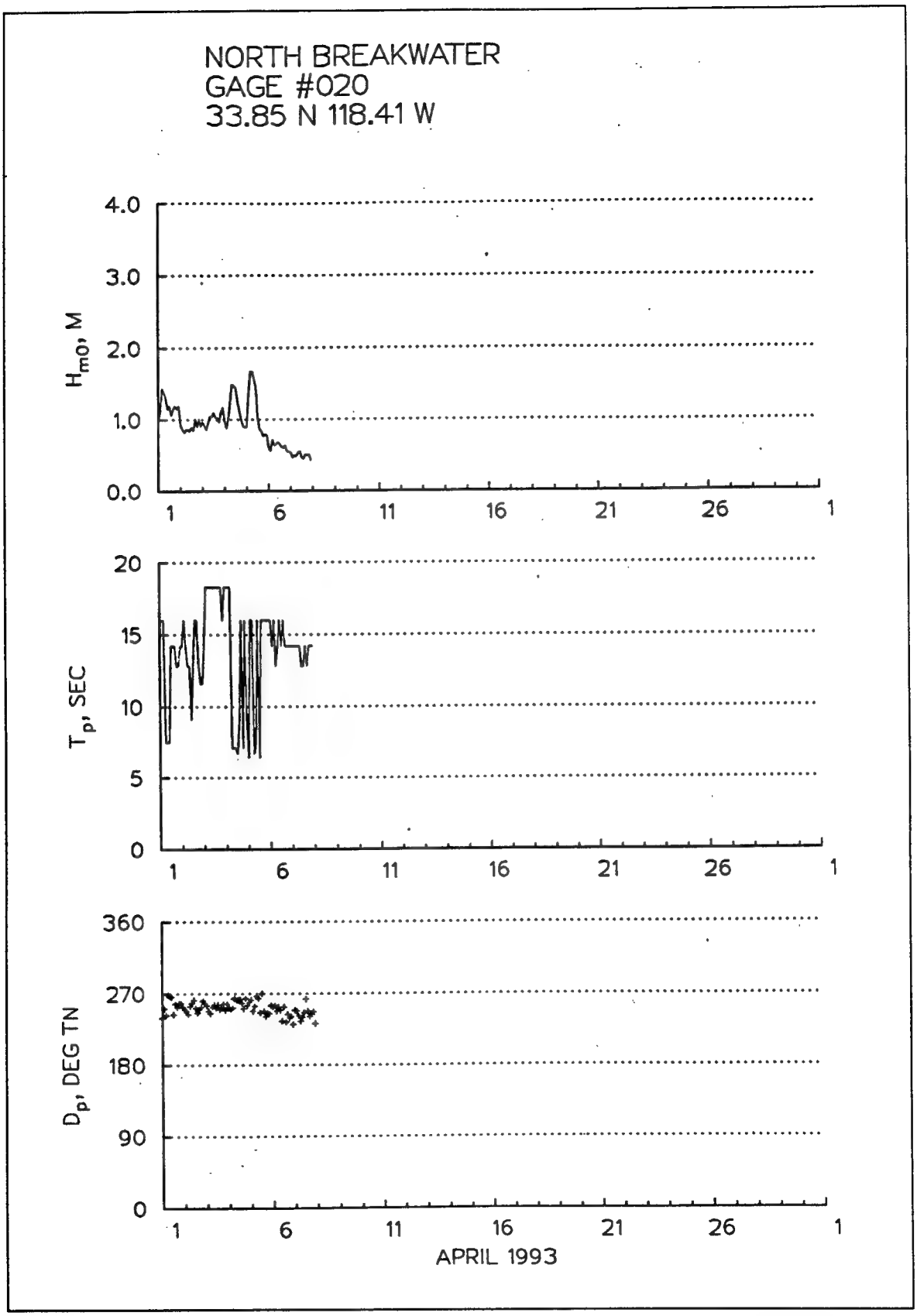

Figure B6. Time series plot for North Breakwater gage (020), April 1993, first deployment

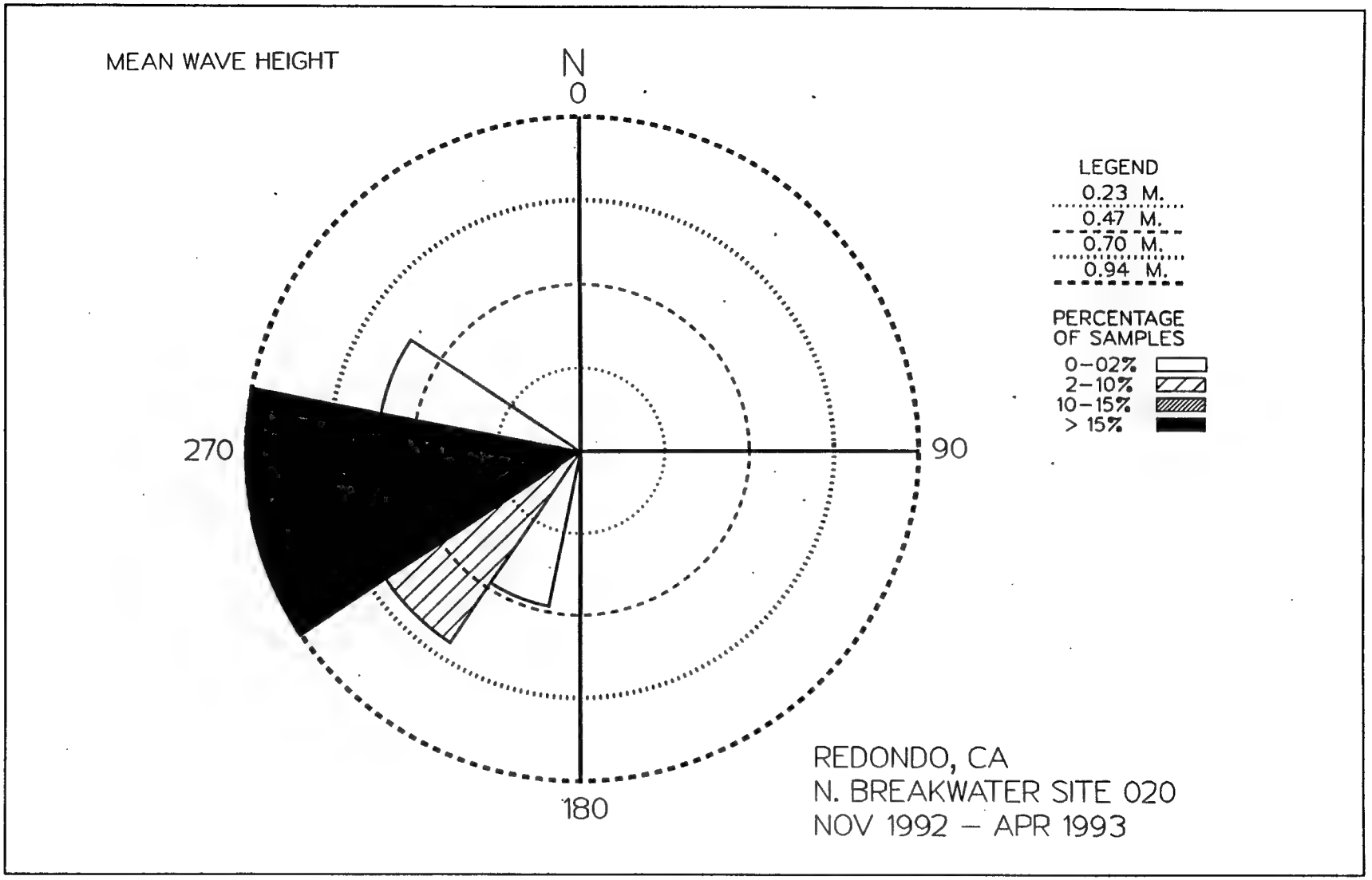

Figure B7. Wave rose for North Breakwater gage (020), first deployment

Table B1
Mean/Max Values for North Breakwater (020)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NORTH BREAKWATER (33.85N 118.41W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
YEAR													
1992	.	.	.	.	.	.	.	.	.	.	0.7	0.8	0.8
1993	0.9	1.3	0.9	0.9	.	.	.	.	.	.	.	.	1.0
MEAN	0.9	1.3	0.9	0.9	.	.	.	.	.	.	0.7	0.8	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NORTH BREAKWATER (33.85N 118.41W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	.	1.4	2.4
1993	3.1	2.9	2.7	1.7	.	.	.	.	.	.	.	.

STATISTICS FOR NORTH BREAKWATER (33.85N 118.41W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.9
THE MEAN PEAK WAVE PERIOD (SECONDS)=	12.3
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	247.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	3.4
THE LARGEST Hm0(METERS)=	3.1
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	11.6
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	257.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93011422

Table B2
Percent Occurrence for North Breakwater(020)
First Deployment

NORTH BREAKWATER, REDONDO BEACH 33.85N 118.41W FOR ALL DIRECTIONS
NOVEMBER 1992 - APRIL 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.5	5.6-7.9	8.0-10.6	10.7-11.5	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	31	15	58	210	137	174	295	226	179	36	1361
0.5-0.9	42	131	385	527	321	474	785	975	1060	247	4947
1.0-1.4	10	47	453	416	179	179	321	327	675	84	2691
1.5-1.9	.	5	137	121	36	89	68	47	116	.	619
2.0-2.4	.	.	42	10	.	10	63	52	94	.	271
2.5-2.9	.	.	5	5	.	5	26	10	31	.	82
3.0-3.4	.	.	.	.	.	5	.	.	.	.	5
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	83	198	1080	1289	673	936	1558	1637	2155	367	

MEAN Hm0(M)= 0.9 LARGEST Hm0(M)= 3.1 MEAN TP(SEC)= 12.3 TOTAL CASES= 1896.

Appendix C
Near Breakwater Site, First Deployment

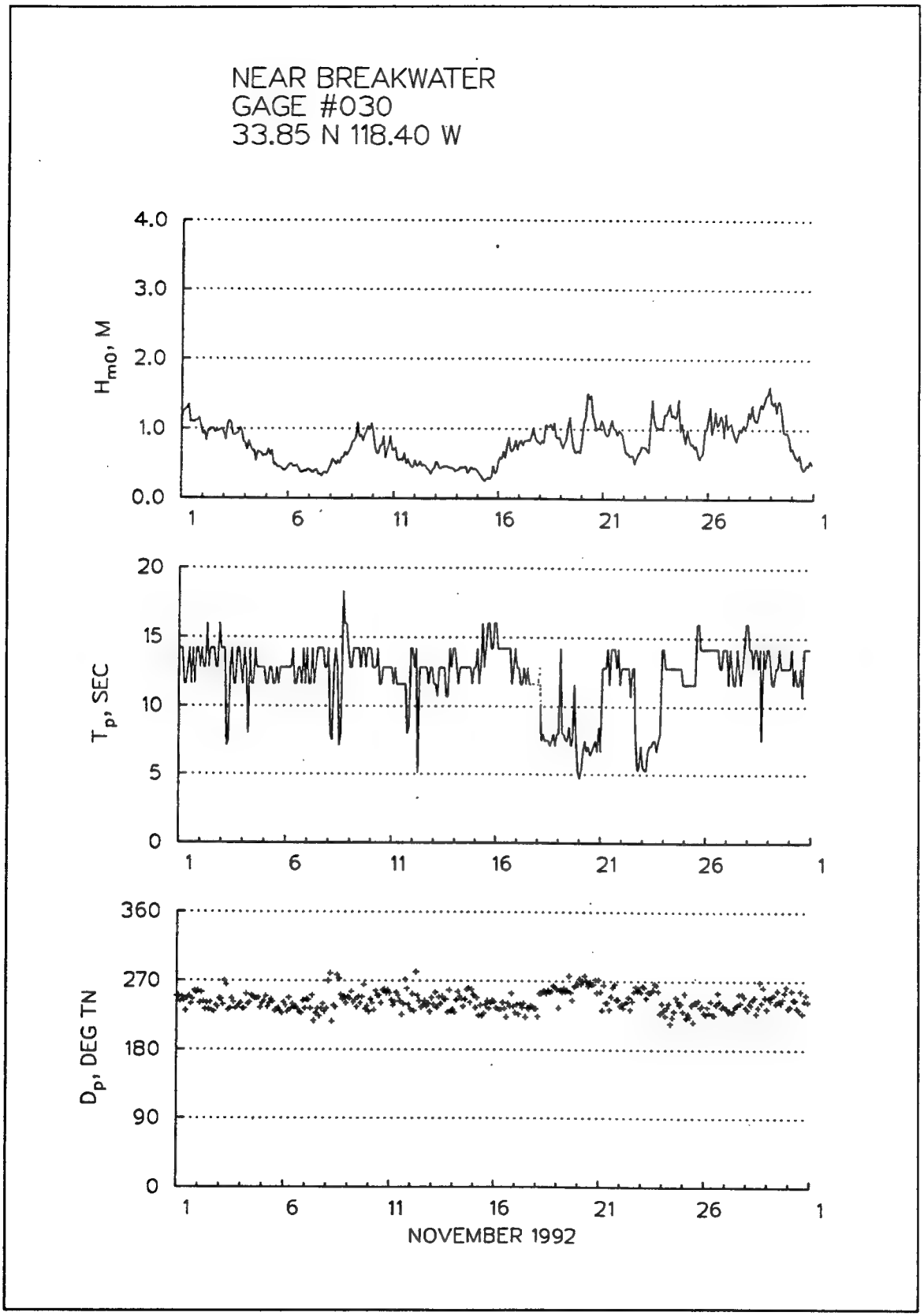

Figure C1. Time series plot for Near Breakwater gage (030), November 1992, first deployment

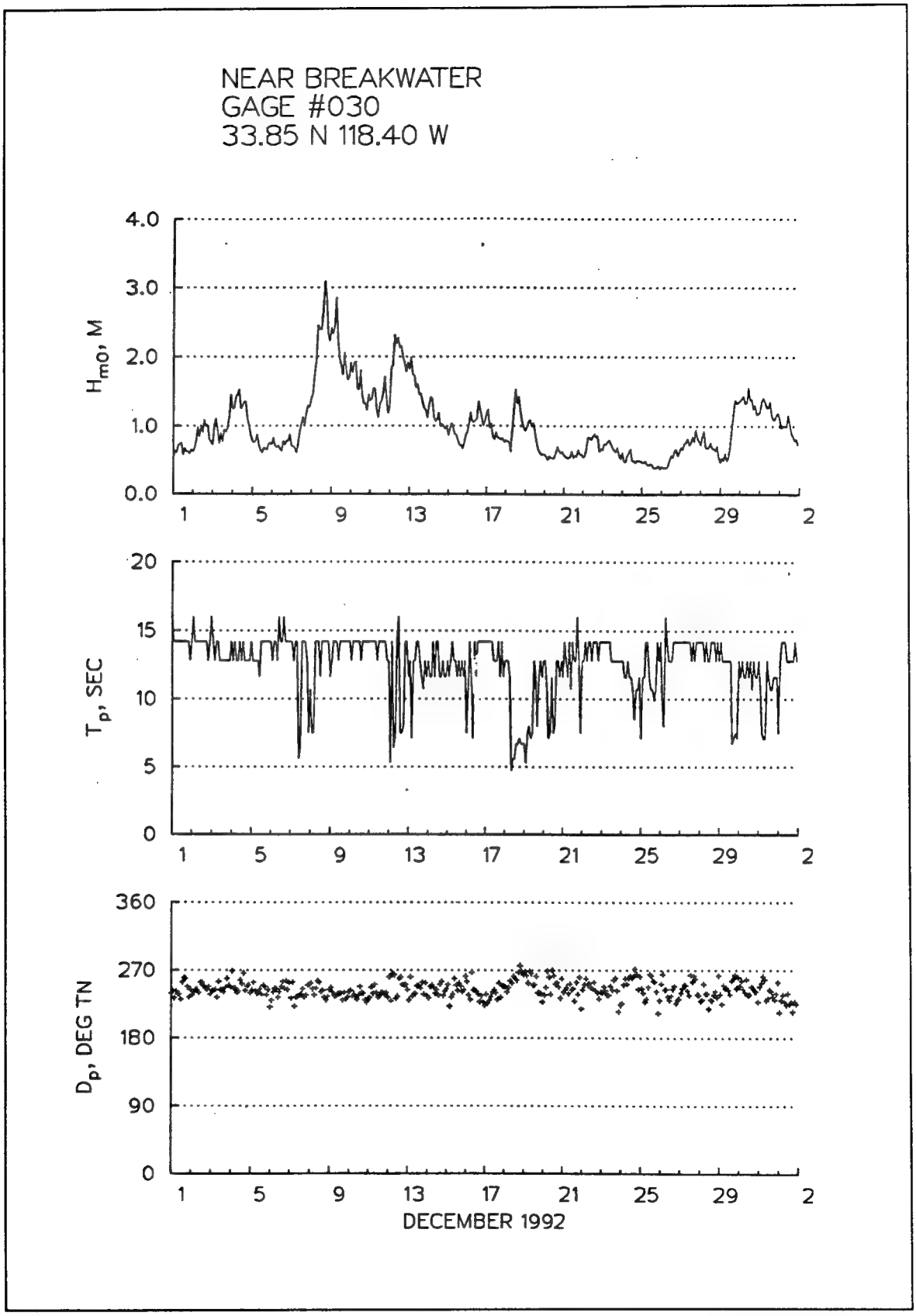

Figure C2. Time series plot for Near Breakwater gage (030), December 1992, first deployment

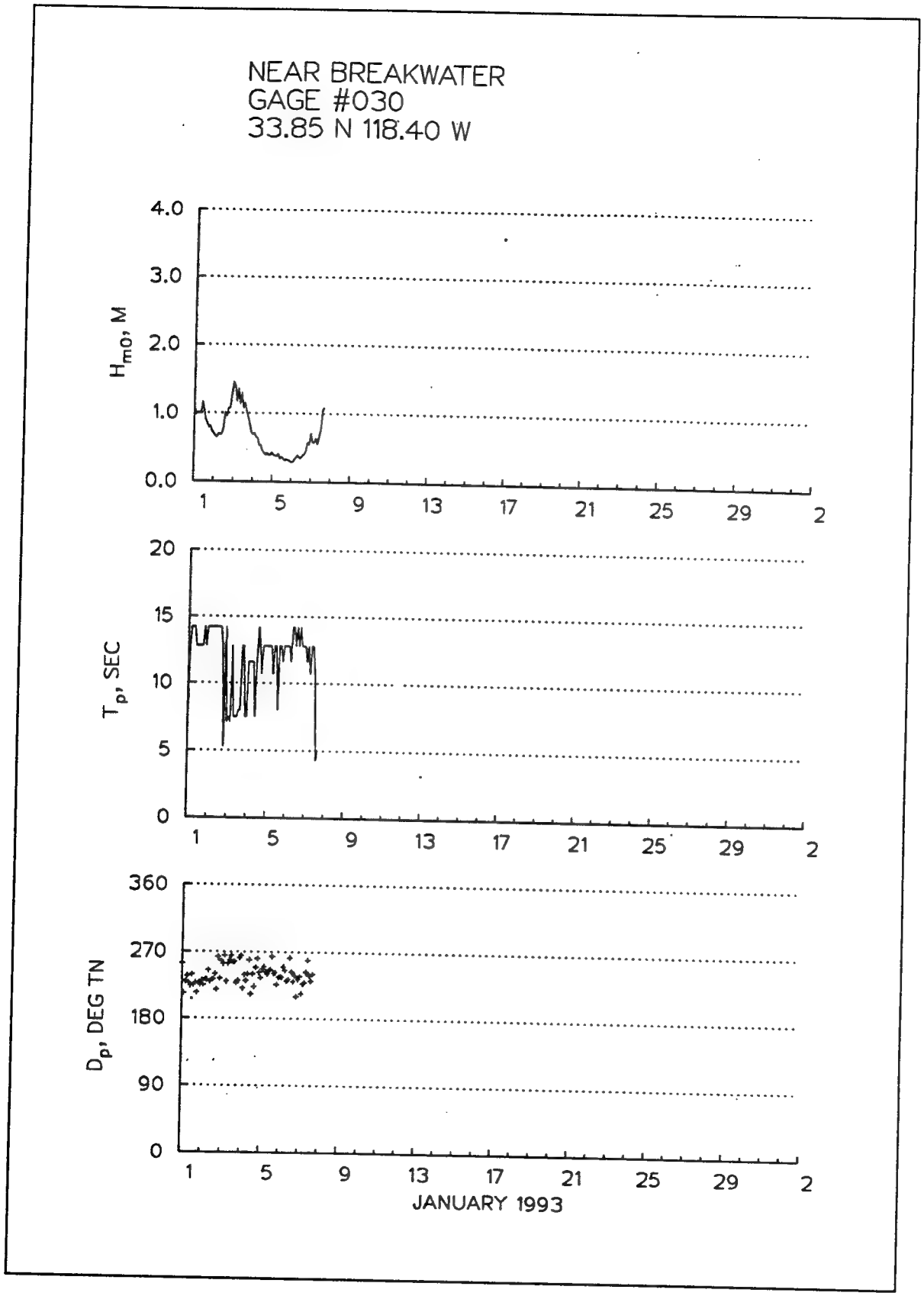

Figure C3. Time series plot for Near Breakwater gage (030), January 1993, first deployment

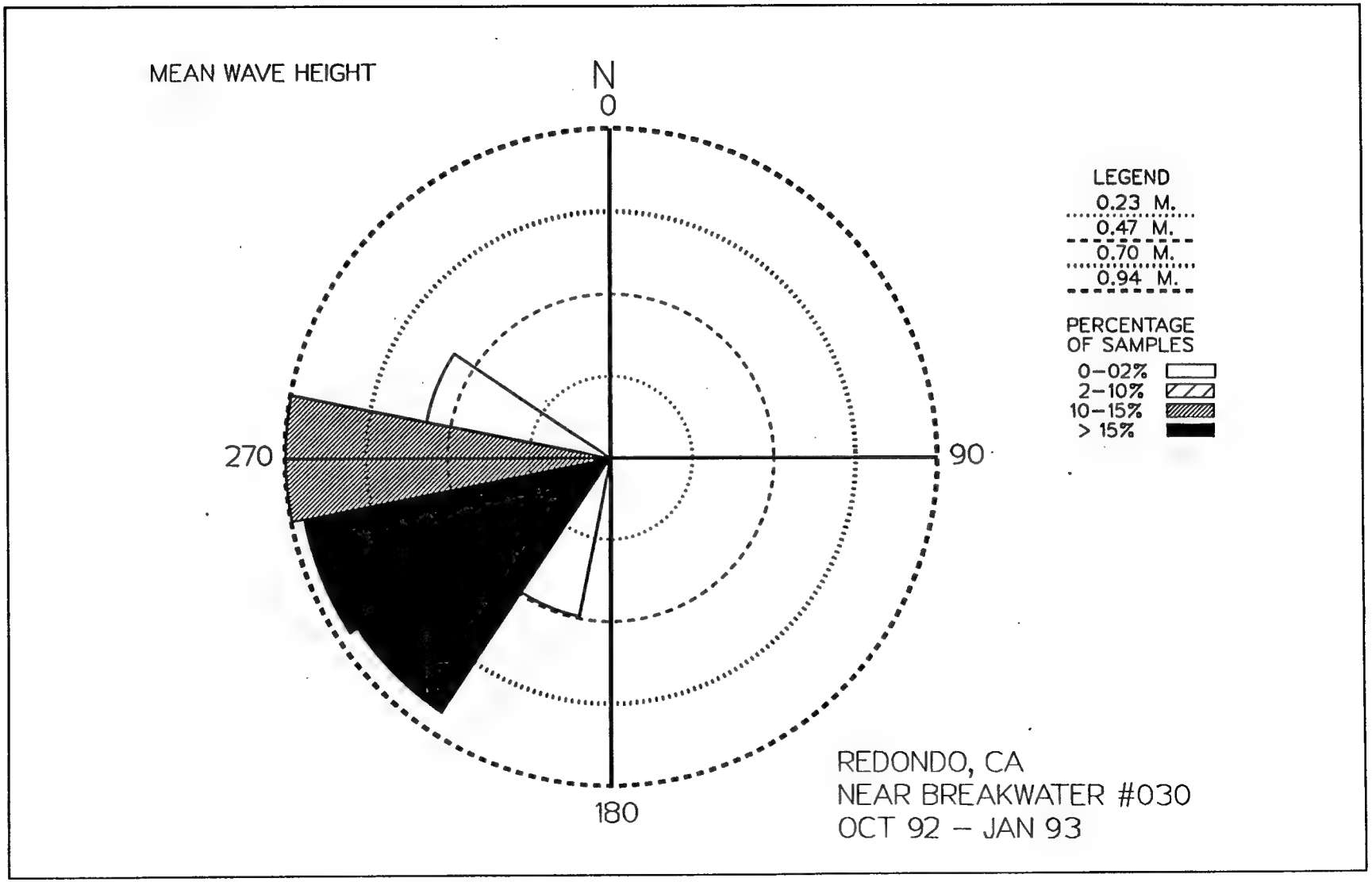

Figure C4. Wave rose for Near Breakwater gage (030), first deployment

Table C1
Mean/Max Values for Near Breakwater (030)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NEAR BREAKWATER (33.85N 118.40W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	1.0	0.8	1.0	0.9
1993	0.7	.	.	.	.	.	.	.	.	.	.	.	0.7
MEAN	0.7	.	.	.	.	.	.	.	.	1.0	0.8	1.0	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NEAR BREAKWATER (33.85N 118.40W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	1.4	1.6	3.1
1993	1.5	.	.	.	.	.	.	.	.	.	.	.

STATISTICS FOR NEAR BREAKWATER (33.85N 118.40W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.9
THE MEAN PEAK WAVE PERIOD (SECONDS)=	12.3
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	247.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	2.5
THE LARGEST Hm0(METERS)=	3.1
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	14.2
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	243.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	92120816

Table C2
Percent Occurrence for Near Breakwater(030)
First Deployment

NEAR BREAKWATER 33.85N 118.40W IRRESPECTIVE OF DIRECTION

OCTOBER 1992 - JANUARY 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	.	.	11	69	127	254	694	335	57	.	1547
0.5-0.9	.	115	289	150	69	775	1759	1666	138	.	4961
1.0-1.4	11	57	590	69	104	381	625	972	34	.	2843
1.5-1.9	.	11	57	11	.	11	92	231	.	.	413
2.0-2.4	.	.	34	.	.	23	11	92	11	.	171
2.5-2.9	.	.	.	.	.	.	.	34	.	.	34
3.0-3.4	.	.	.	.	.	.	.	11	.	.	11
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	11	183	981	299	300	1444	3181	3341	240	0	

MEAN Hm0(M)= 0.9 LARGEST Hm0(M)= 3.1 MEAN TP(SEC)= 12.3 TOTAL CASES= 864.

Appendix D
South Breakwater Site, First Deployment

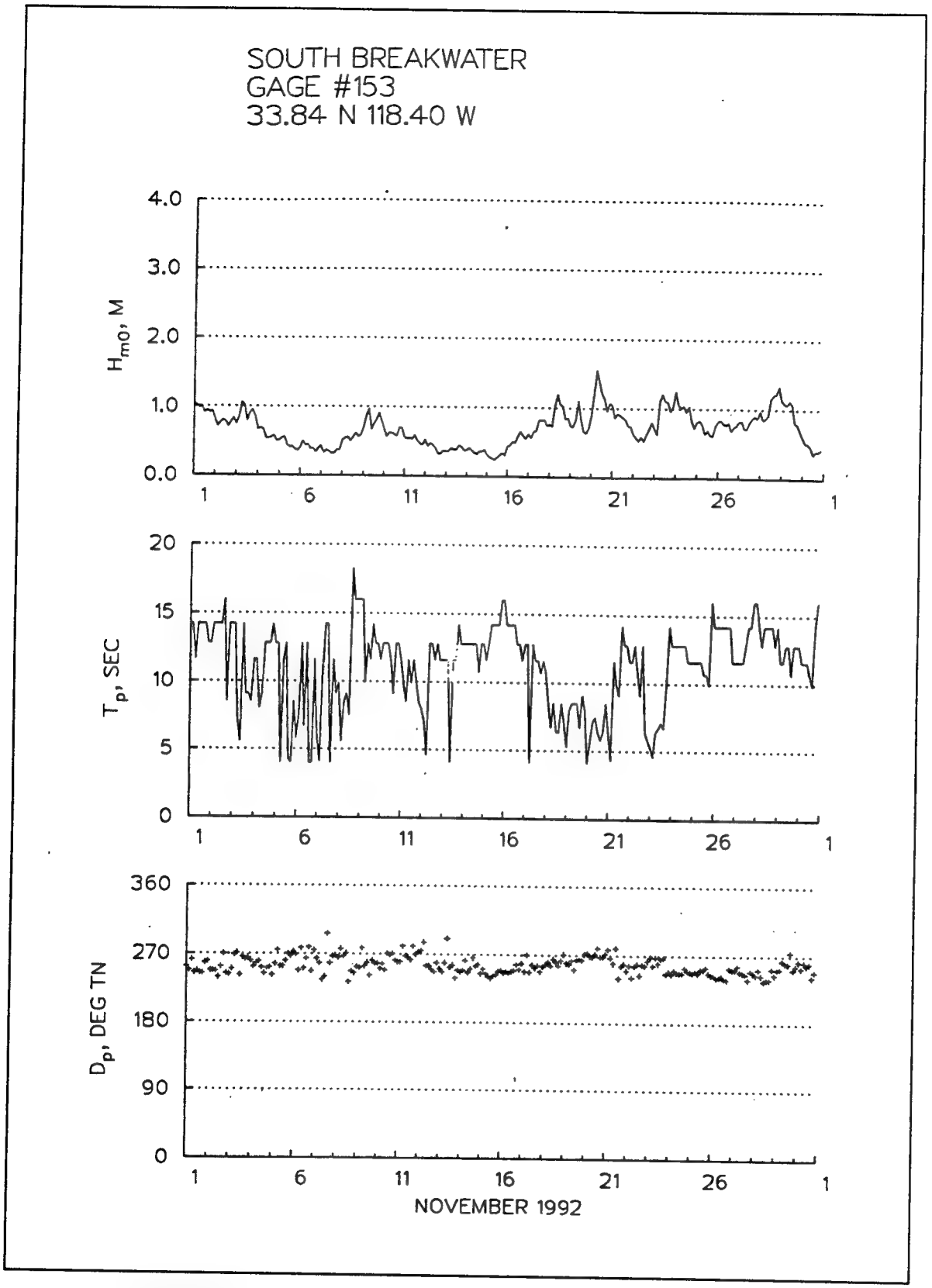

Figure D1. Time series plot for South Breakwater gage (153), November 1992, first deployment

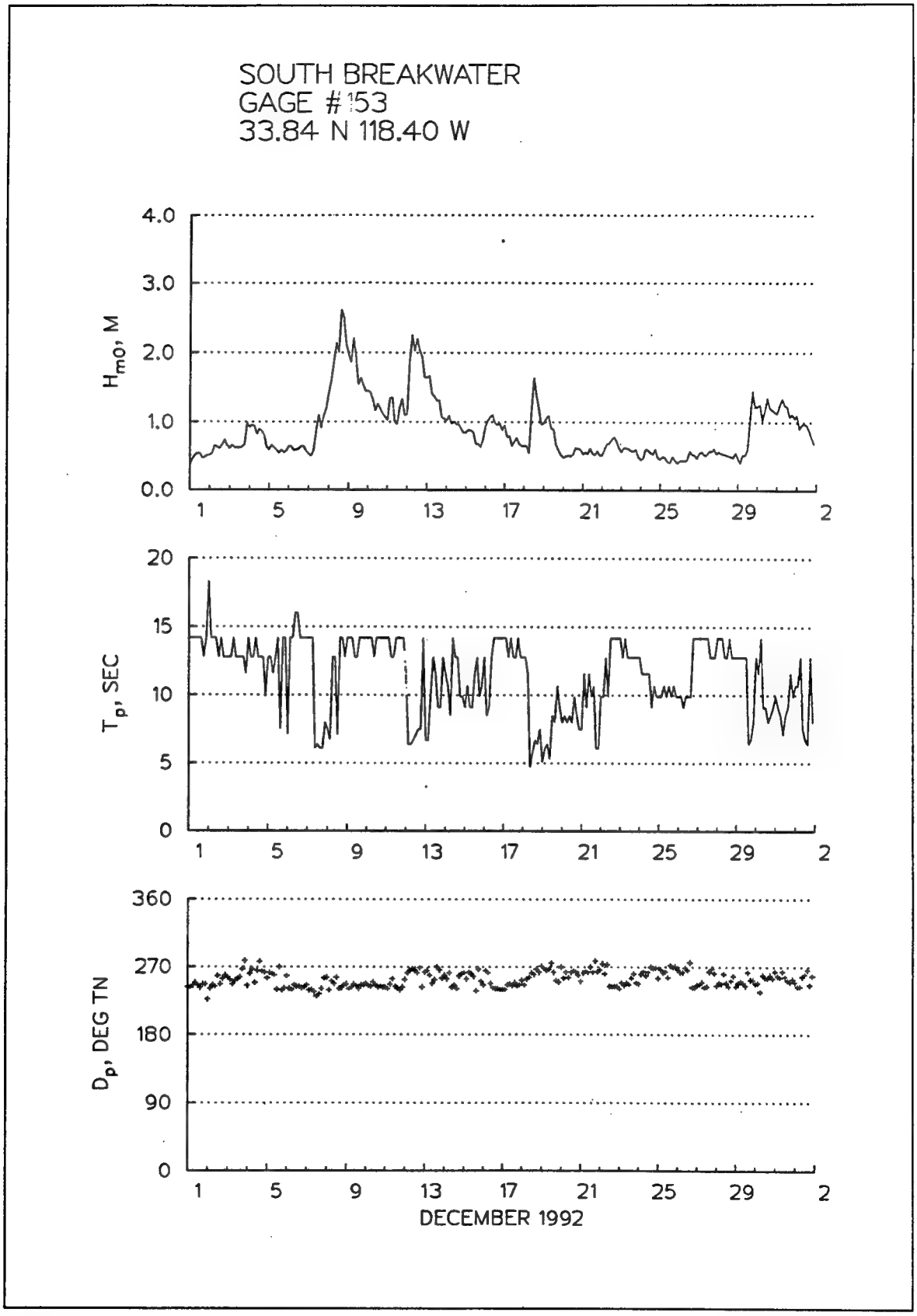

Figure D2. Time series for South Breakwater gage (153), December 1992, first deployment

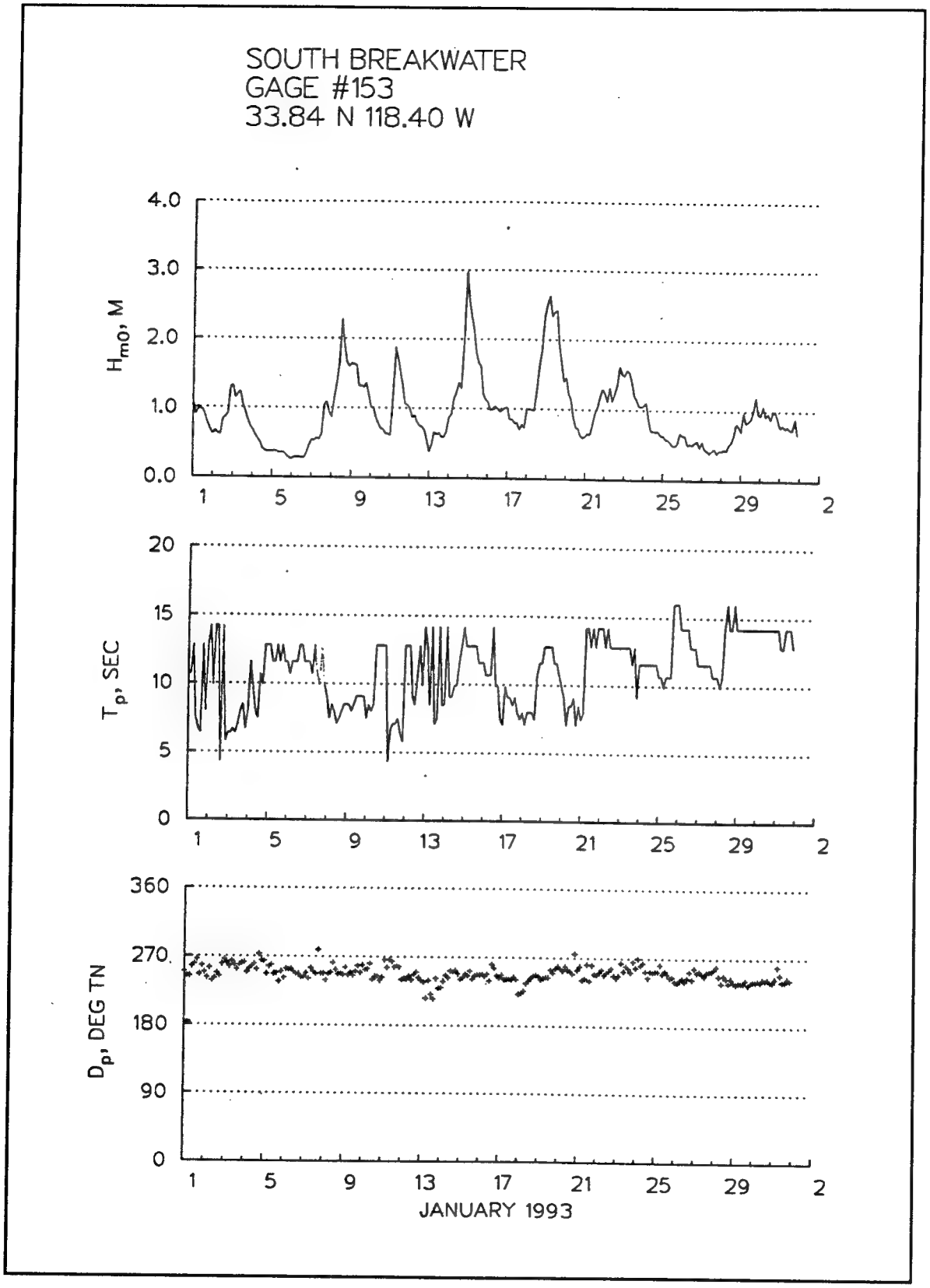

Figure D3. Time series plot for South Breakwater gage (153), January 1993, first deployment

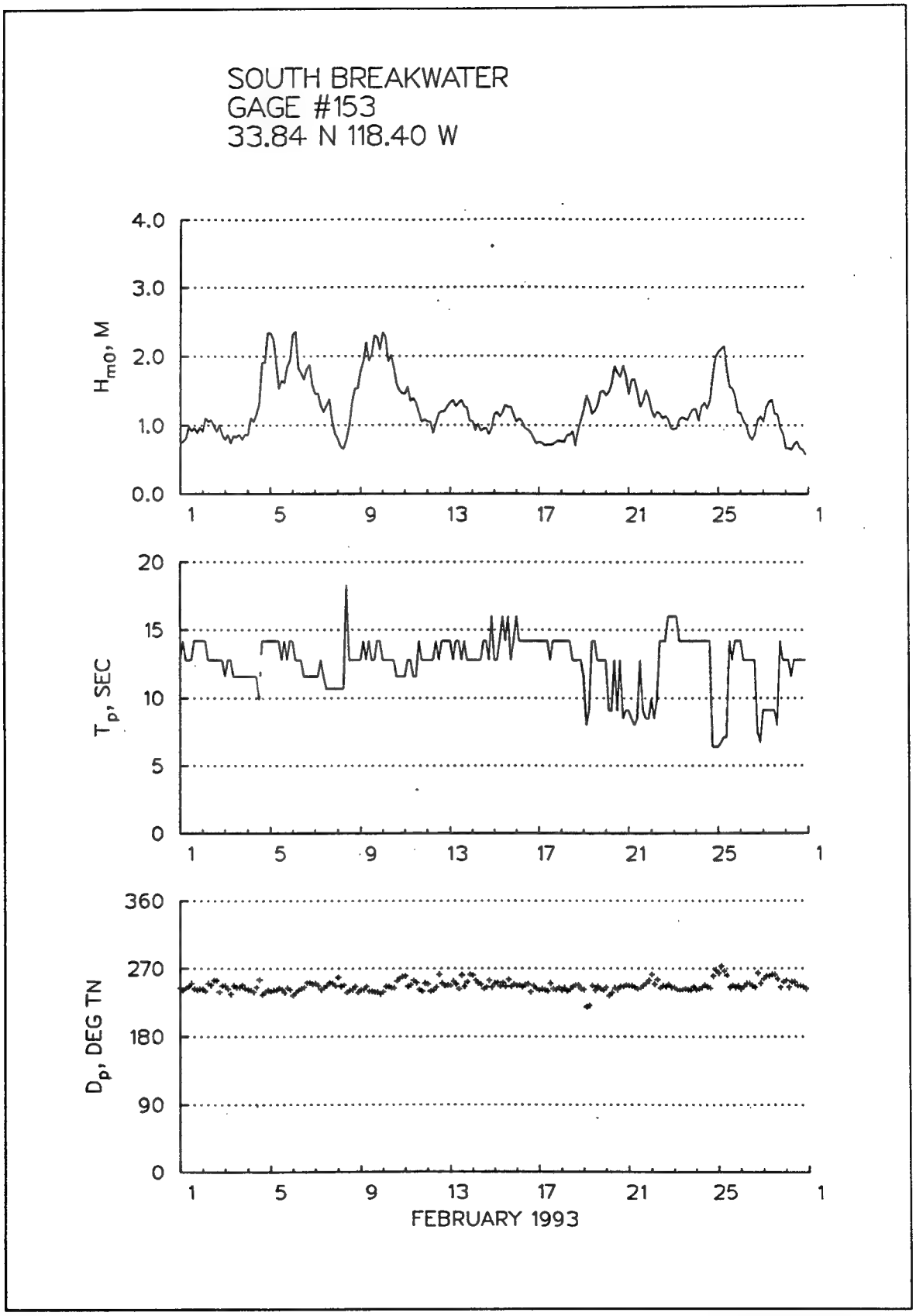

Figure D4. Time series for South Breakwater gage (153), February 1993, first deployment

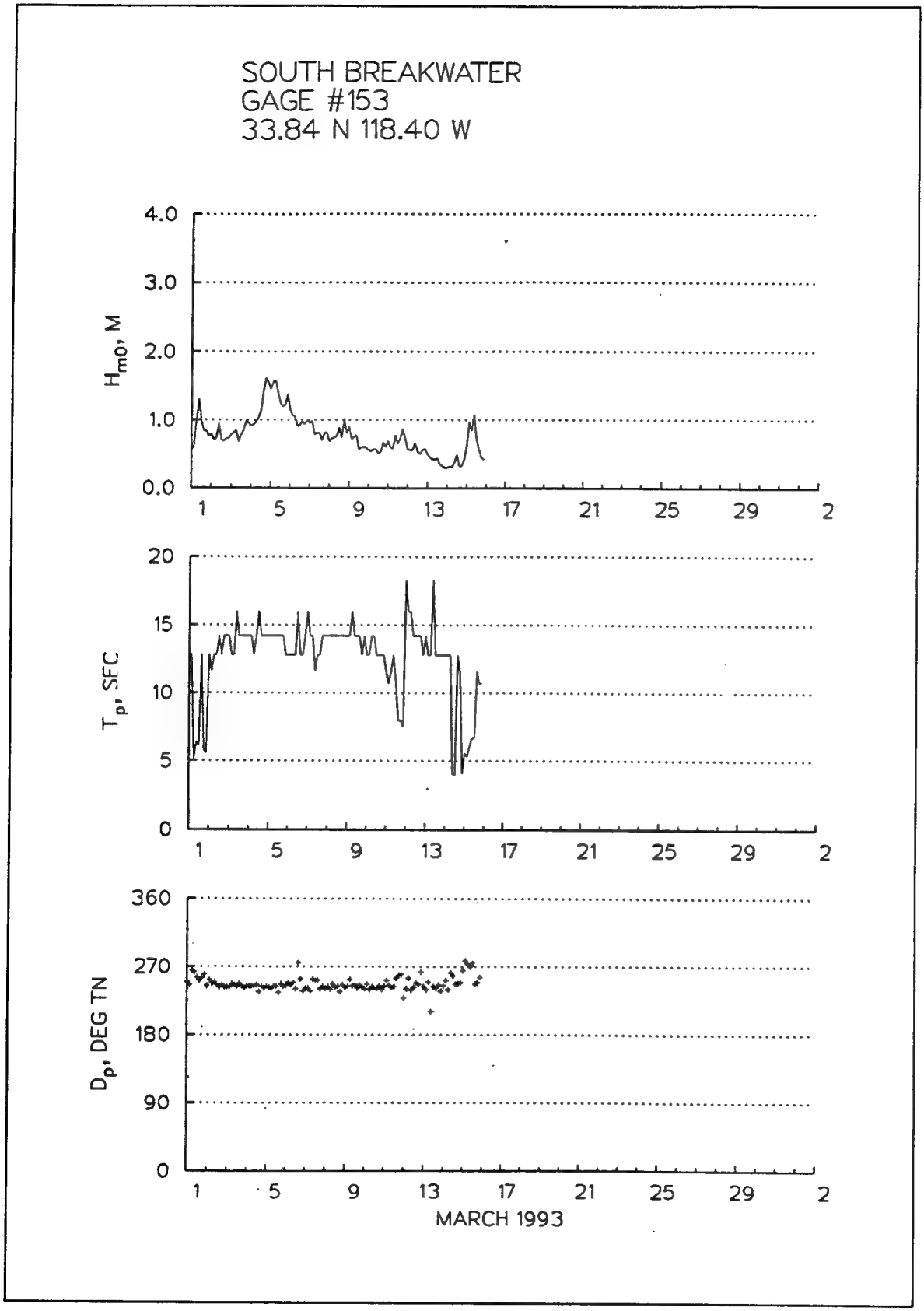

Figure D5. Time series for South Breakwater gage (153), March 1993, first deployment

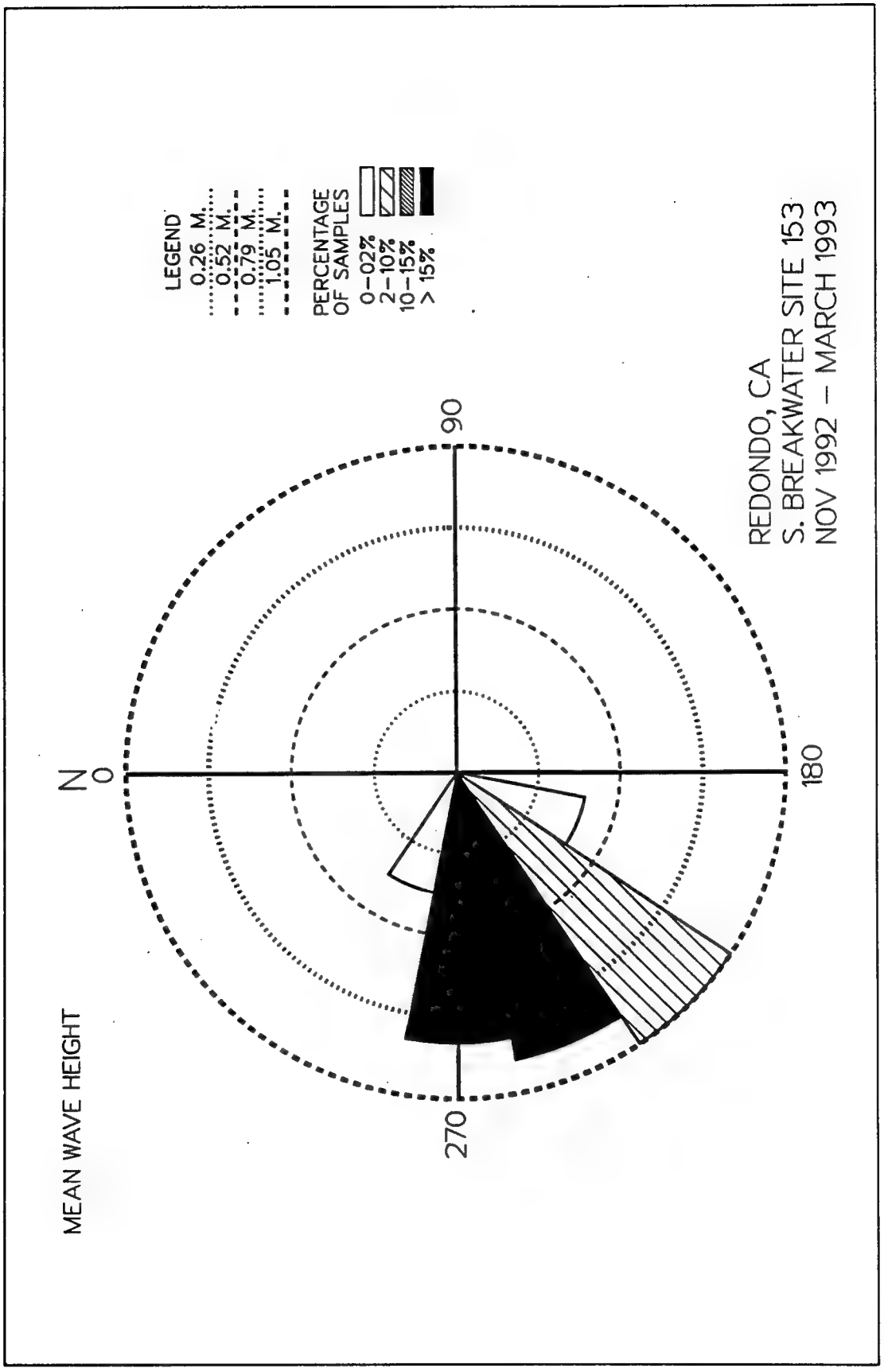

Figure D6. Wave rose for South Breakwater gage (153), first deployment

Table D1
Mean/Max Values for South Breakwater (153)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
SOUTH BREAKWATER (33.84N 118.40W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	.	0.7	0.9	0.8
1993	1.0	1.3	0.8	.	.	.	.	.	.	.	.	.	1.0
MEAN	1.0	1.3	0.8	.	.	.	.	.	.	.	0.7	0.9	

LARGEST Hm0(METERS) BY MONTH AND YEAR
SOUTH BREAKWATER (33.84N 118.40W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	.	1.6	2.6
1993	3.0	2.4	1.6	.	.	.	.	.	.	.	.	.

STATISTICS FOR SOUTH BREAKWATER (33.84N 118.40W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.9
THE MEAN PEAK WAVE PERIOD (SECONDS)=	11.7
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	247.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	2.8
THE LARGEST Hm0(METERS)=	3.0
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	12.8
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	248.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93011421

Table D2
Percent Occurrence for South Breakwater (153)
First Deployment

SOUTH BREAKWATER 37.84N 118.40W IRRESPECTIVE OF DIRECTION

NOVEMBER 1992 - MARCH 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	92	9	46	148	138	259	388	138	27	.	1245
0.5-0.9	46	55	324	824	259	564	1342	1564	231	.	5209
1.0-1.4	9	18	398	509	64	222	500	685	46	.	2451
1.5-1.9	.	.	129	120	9	83	222	166	.	.	729
2.0-2.4	.	.	92	.	.	9	129	64	.	.	294
2.5-2.9	.	.	.	.	.	9	18	27	.	.	54
3.0-3.4	.	.	.	.	.	.	.	.	.	.	0
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	147	82	989	1601	470	1146	2599	2644	304	0	

MEAN Hm0(M)= 0.9 LARGEST Hm0(M)= 3.0 MEAN TP(SEC)= 11.7 TOTAL CASES= 1080.

Appendix E
Canyon Site, First Deployment

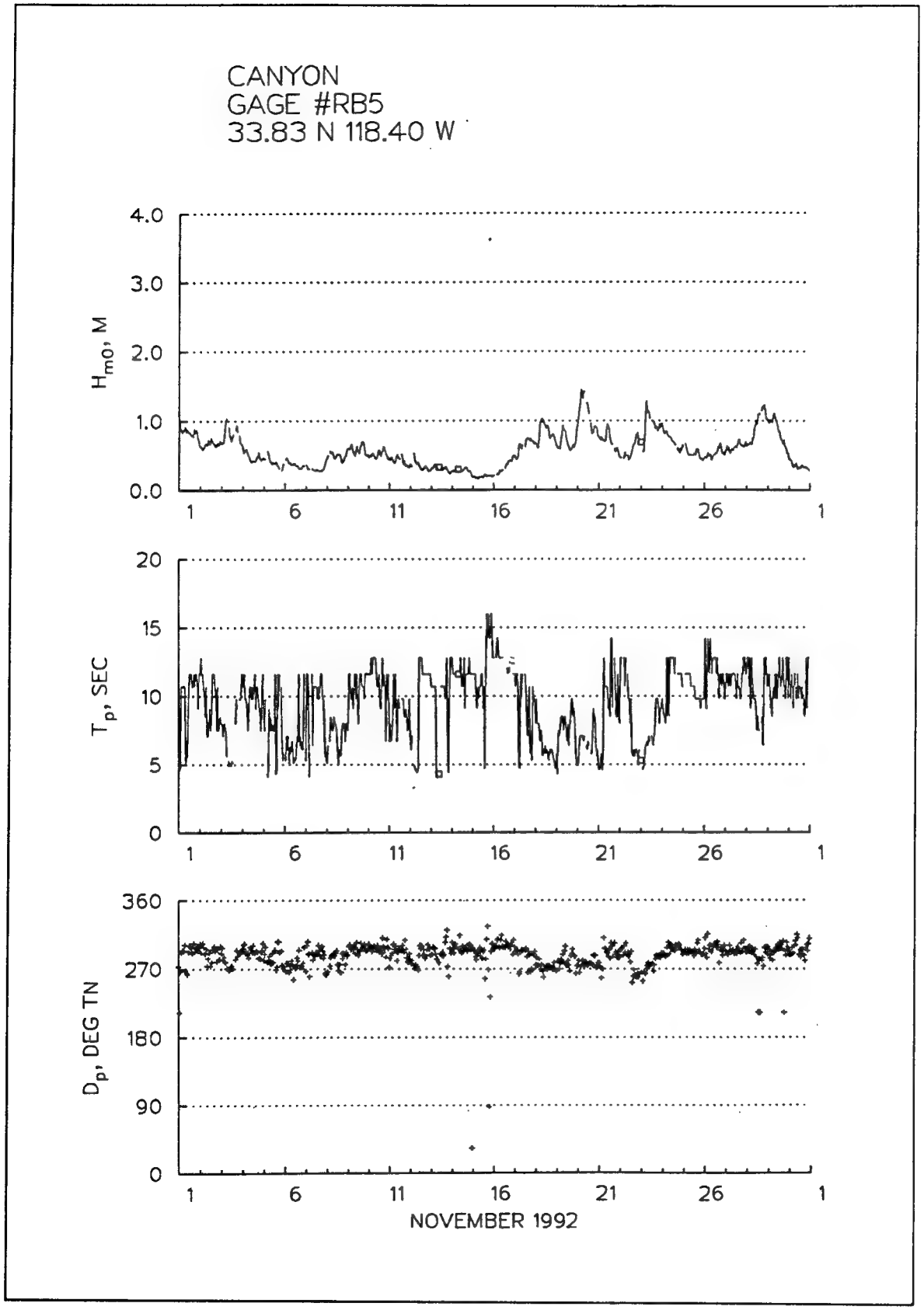

Figure E1. Time series plot for Canyon gage (RB5), November 1992, first deployment

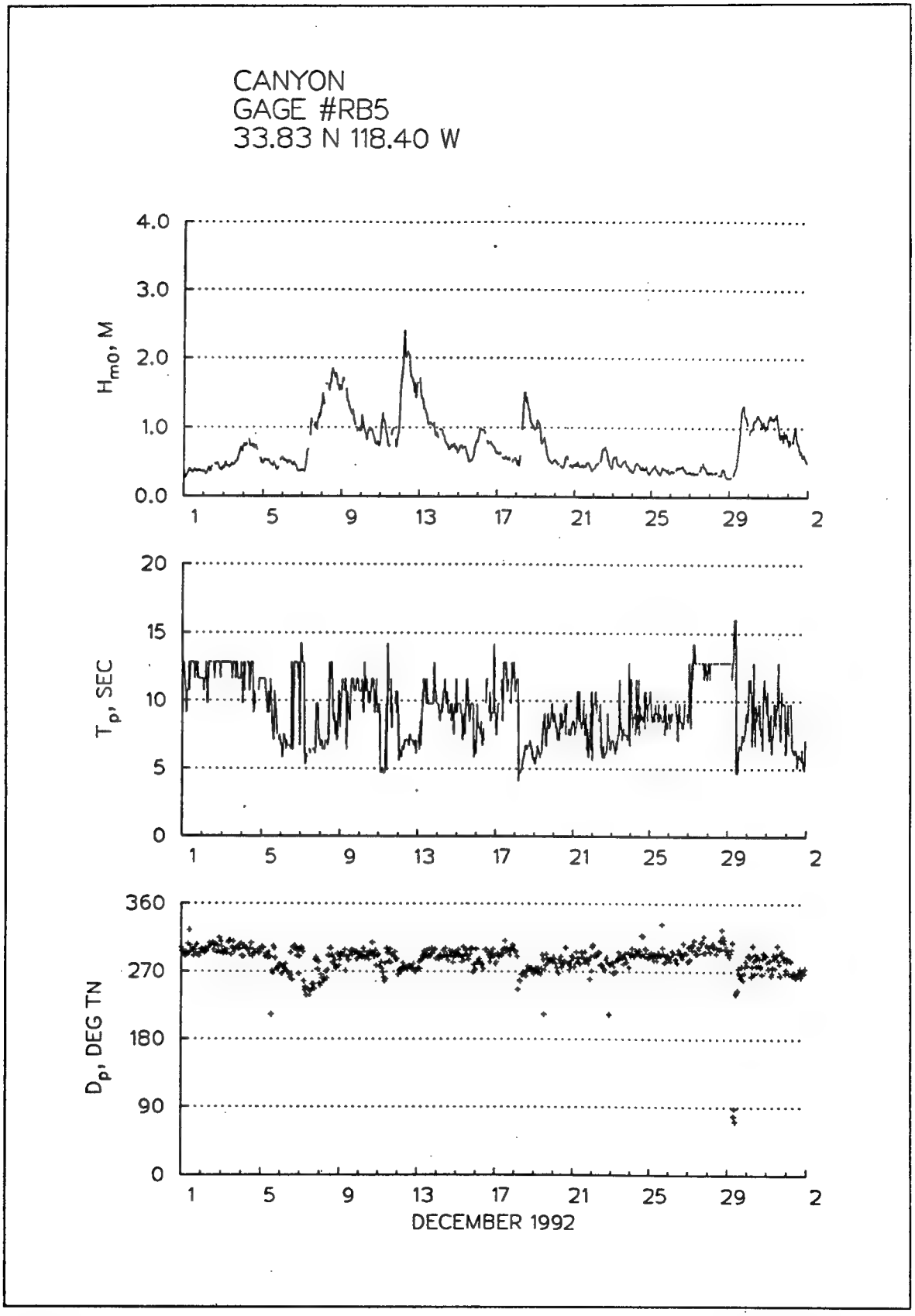

Figure E2. Time series plot for Canyon gage (RB5), December 1992, first deployment

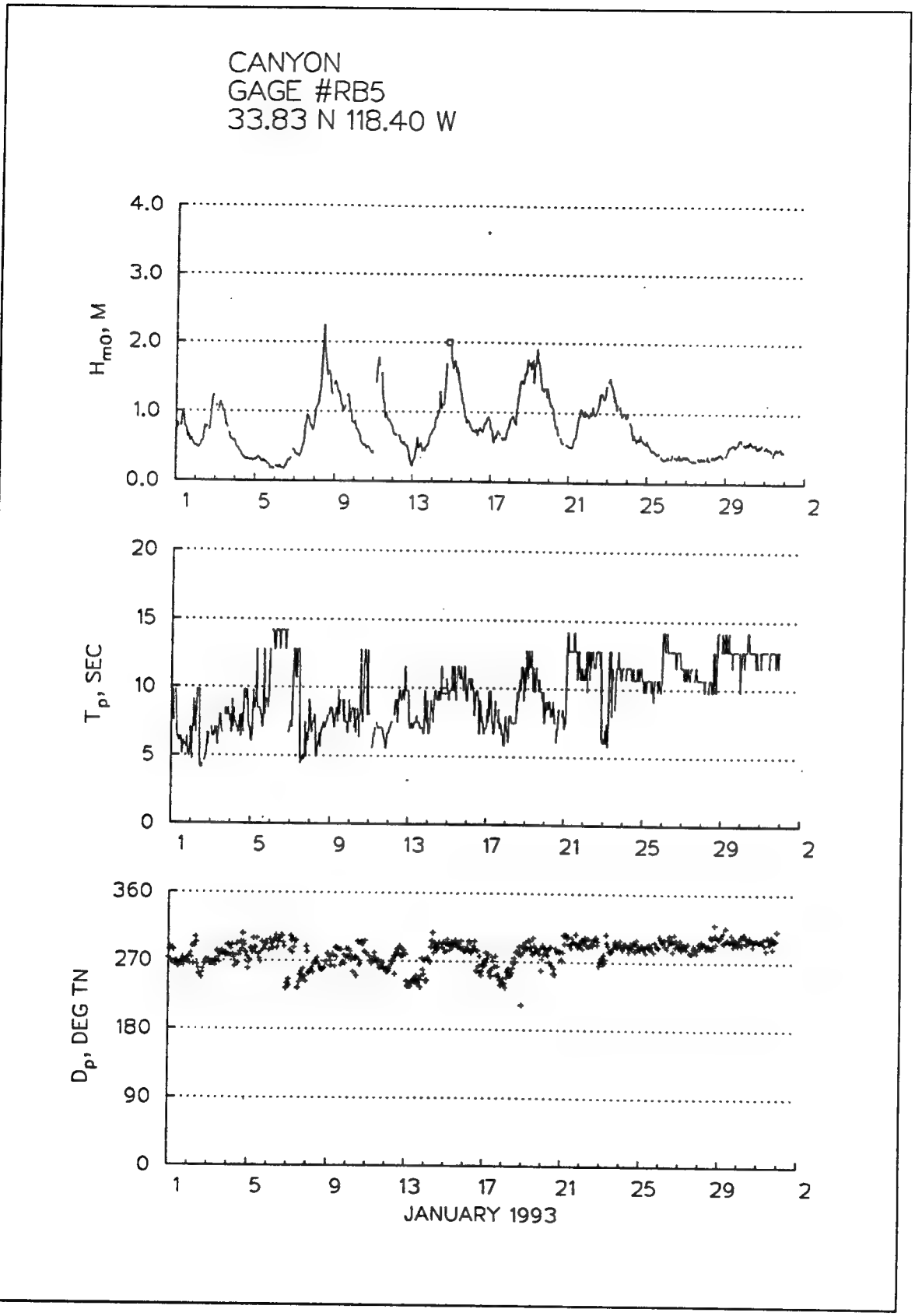

Figure E3. Time series plot for Canyon gage (RB5), January 1993, first deployment

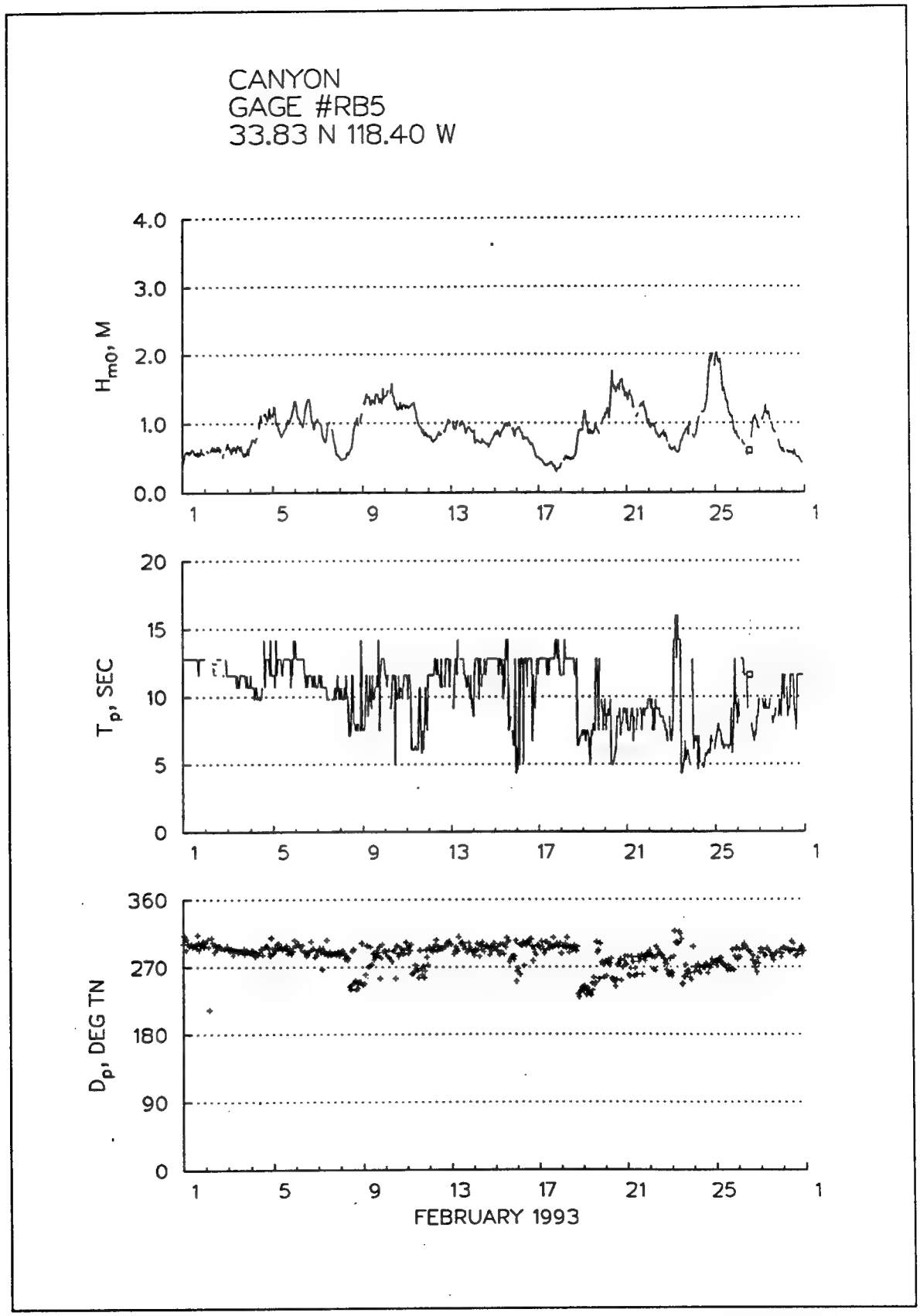

Figure E4. Time series plot for Canyon gage (RB5), February 1993, first deployment

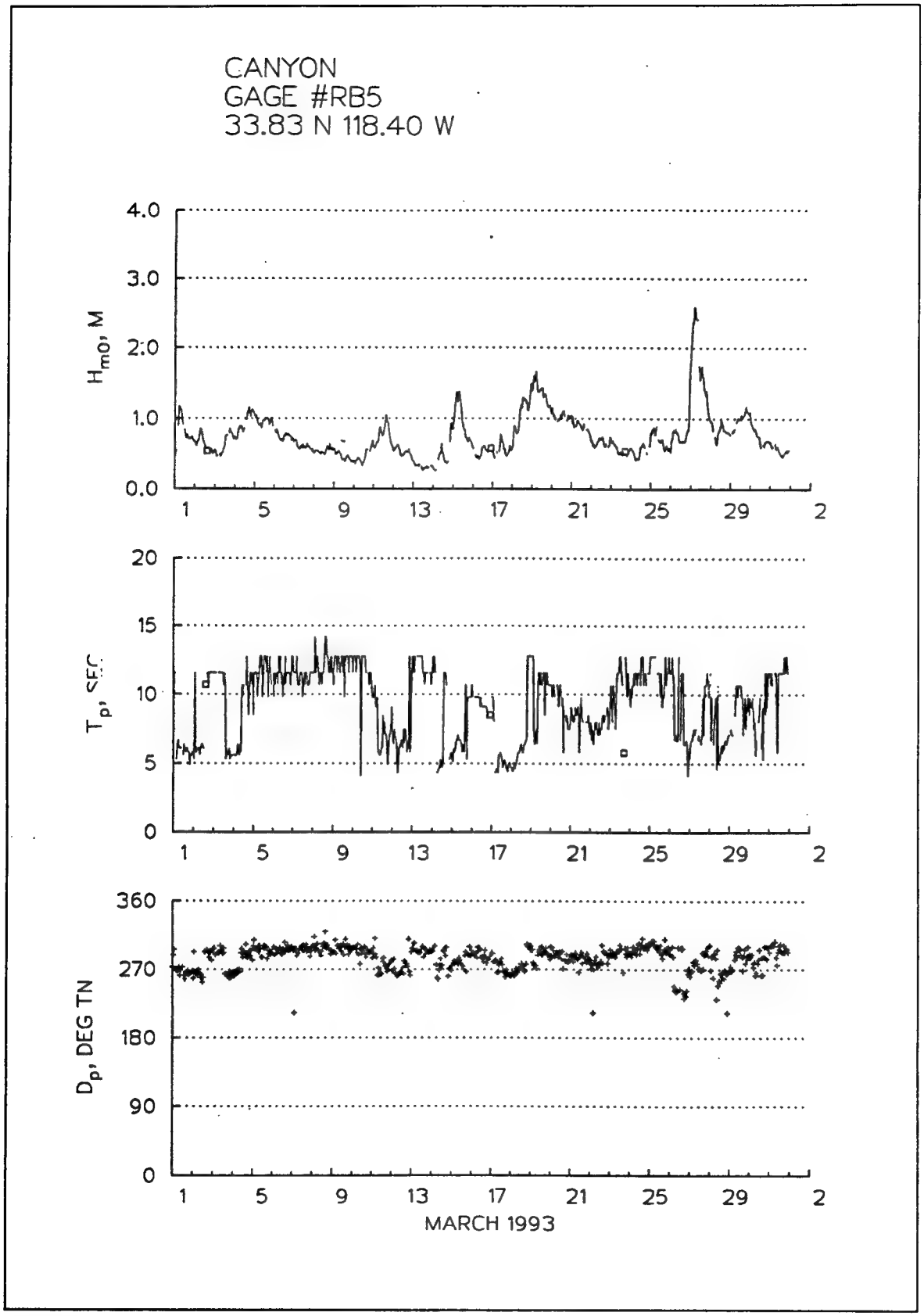

Figure E5. Time series plot for Canyon gage (RB5), March 1993, first deployment

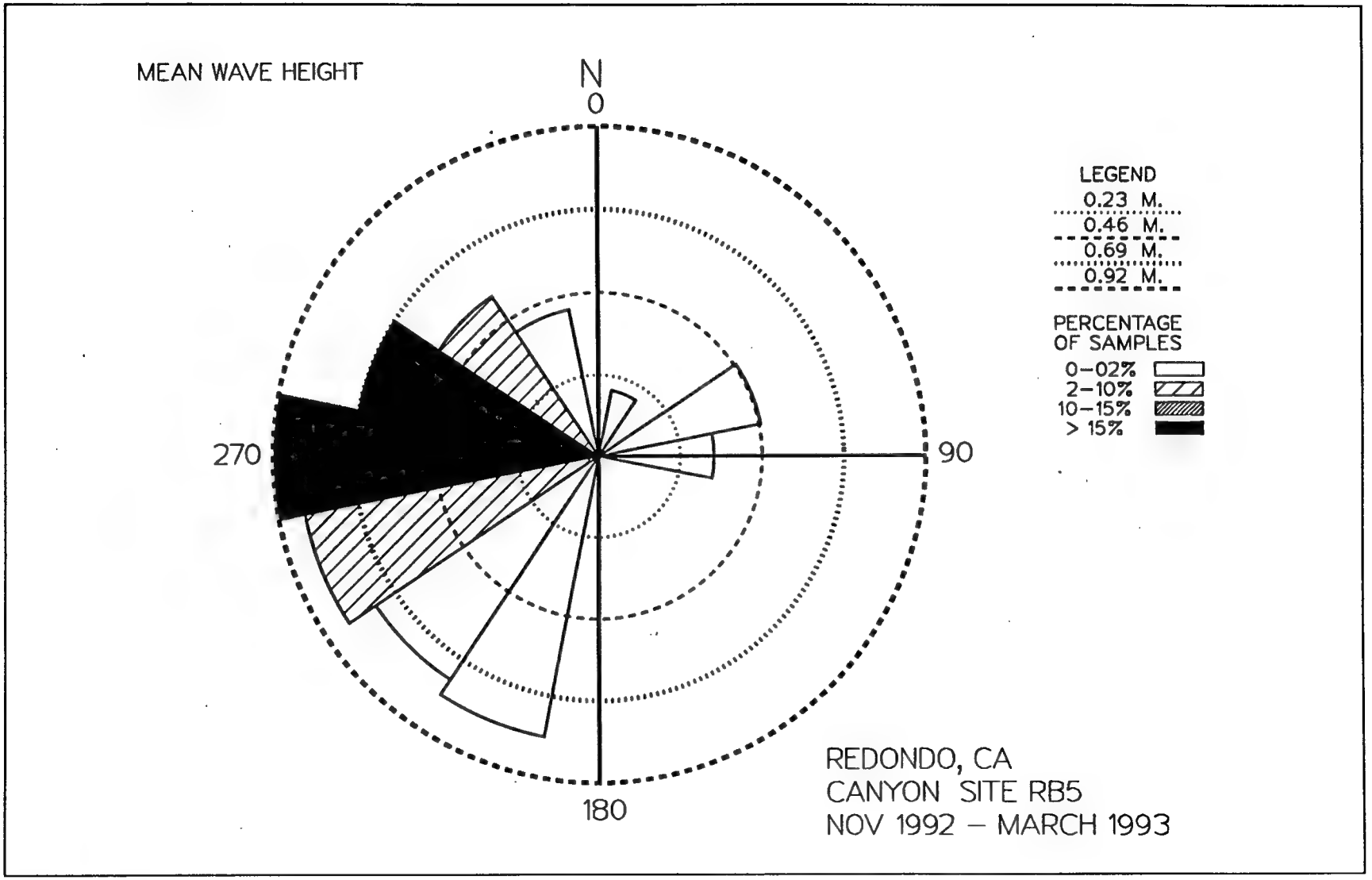

Figure E6. Wave rose for Canyon gage (RB5), first deployment

Table E1
Mean/Max Values for Canyon (RB5)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
CANYON (33.84N 118.40W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	.	0.6	0.7	0.7
1993	0.8	0.9	0.8	.	.	.	.	.	.	.	.	.	0.8
MEAN	0.8	0.9	0.8	.	.	.	.	.	.	.	0.6	0.7	

LARGEST Hm0(METERS) BY MONTH AND YEAR
CANYON (33.84N 118.40W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	.	1.5	2.4
1993	2.3	2.0	2.6	.	.	.	.	.	.	.	.	.

STATISTICS FOR CANYON (33.84N 118.40W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.7
THE MEAN PEAK WAVE PERIOD (SECONDS)=	9.6
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	292.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	2.5
THE LARGEST Hm0(METERS)=	2.6
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	7.1
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	268.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93032704

Table E2
Percent Occurrence for Canyon (RB5)
First Deployment

CANYON 33.84N 118.40W IRRESPECTIVE OF DIRECTION

NOVEMBER 1992 - MARCH 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	28	52	347	668	298	463	683	109	17	.	2665
0.5-0.9	54	283	1143	1392	564	911	761	66	8	.	5182
1.0-1.4	2	57	552	515	188	228	147	26	.	.	1715
1.5-1.9	.	11	188	75	23	37	26	.	.	.	360
2.0-2.4	.	.	54	2	.	.	.	.	.	.	56
2.5-2.9	.	.	5	.	.	.	.	.	.	.	5
3.0-3.4	.	.	.	.	.	.	.	.	.	.	0
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	84	403	2289	2652	1073	1639	1617	201	25	0	

MEAN Hm0(M)= 0.7 LARGEST Hm0(M)= 2.6 MEAN TP(SEC)= 9.6 TOTAL CASES= 3455.

Appendix F
Redondo Site, First Deployment

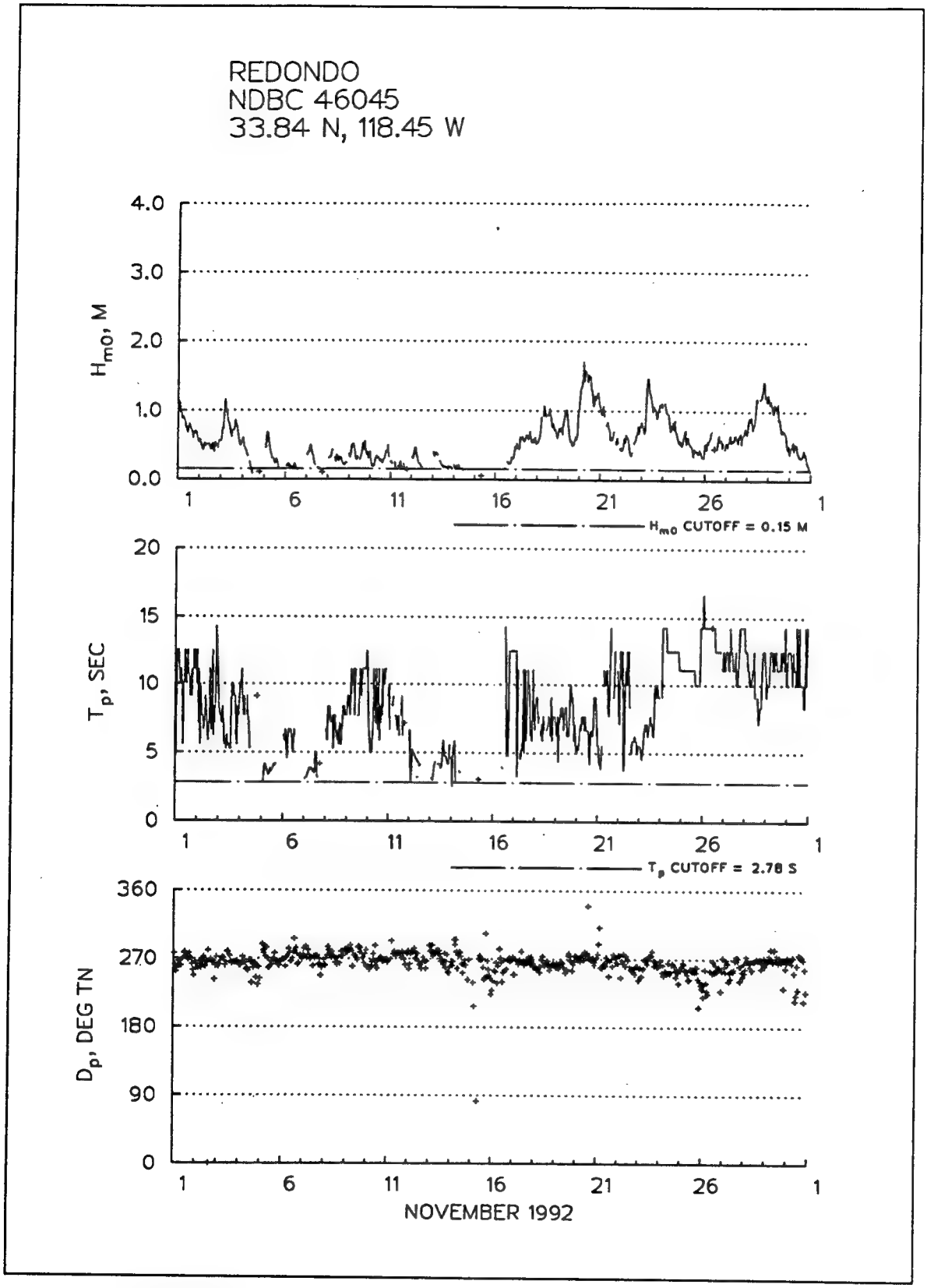

Figure F1. Time series plot for Redondo gage (NDBC 46045), November 1992, first deployment

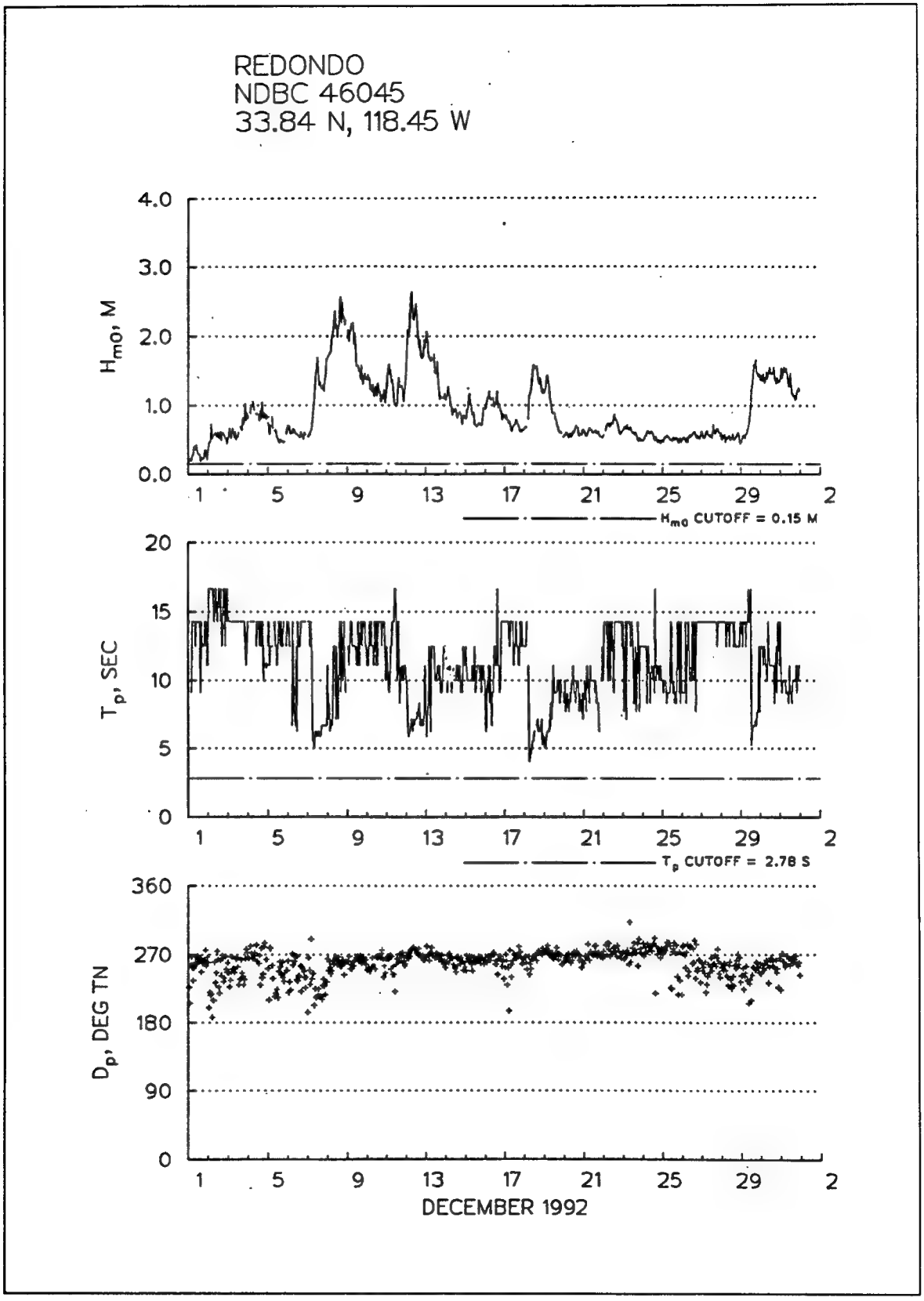

Figure F2. Time series plot for Redondo gage (NDBC 46045), December 1992, first deployment

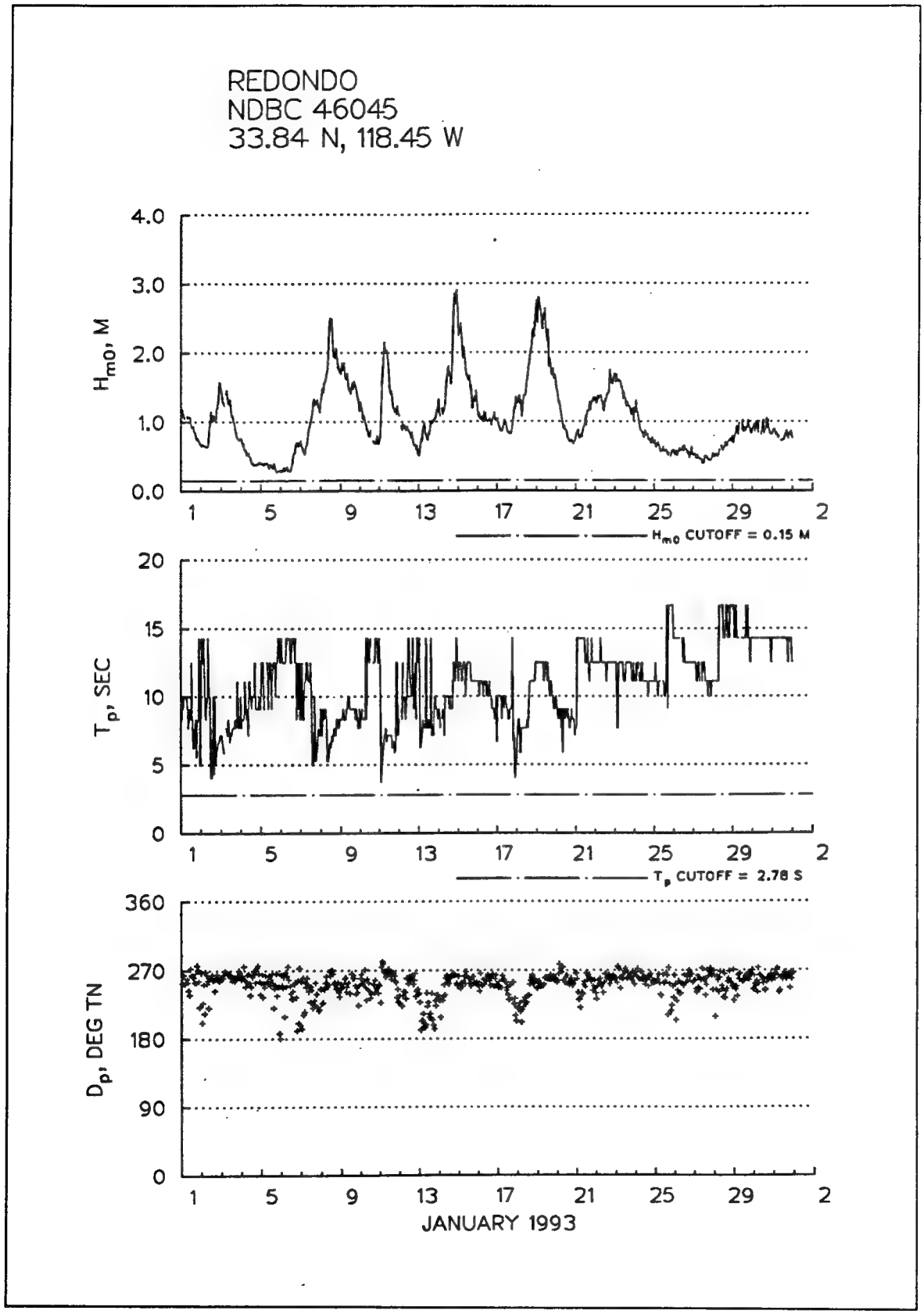

Figure F3. Time series plot for Redondo gage (NDBC 46045), January 1993, first deployment

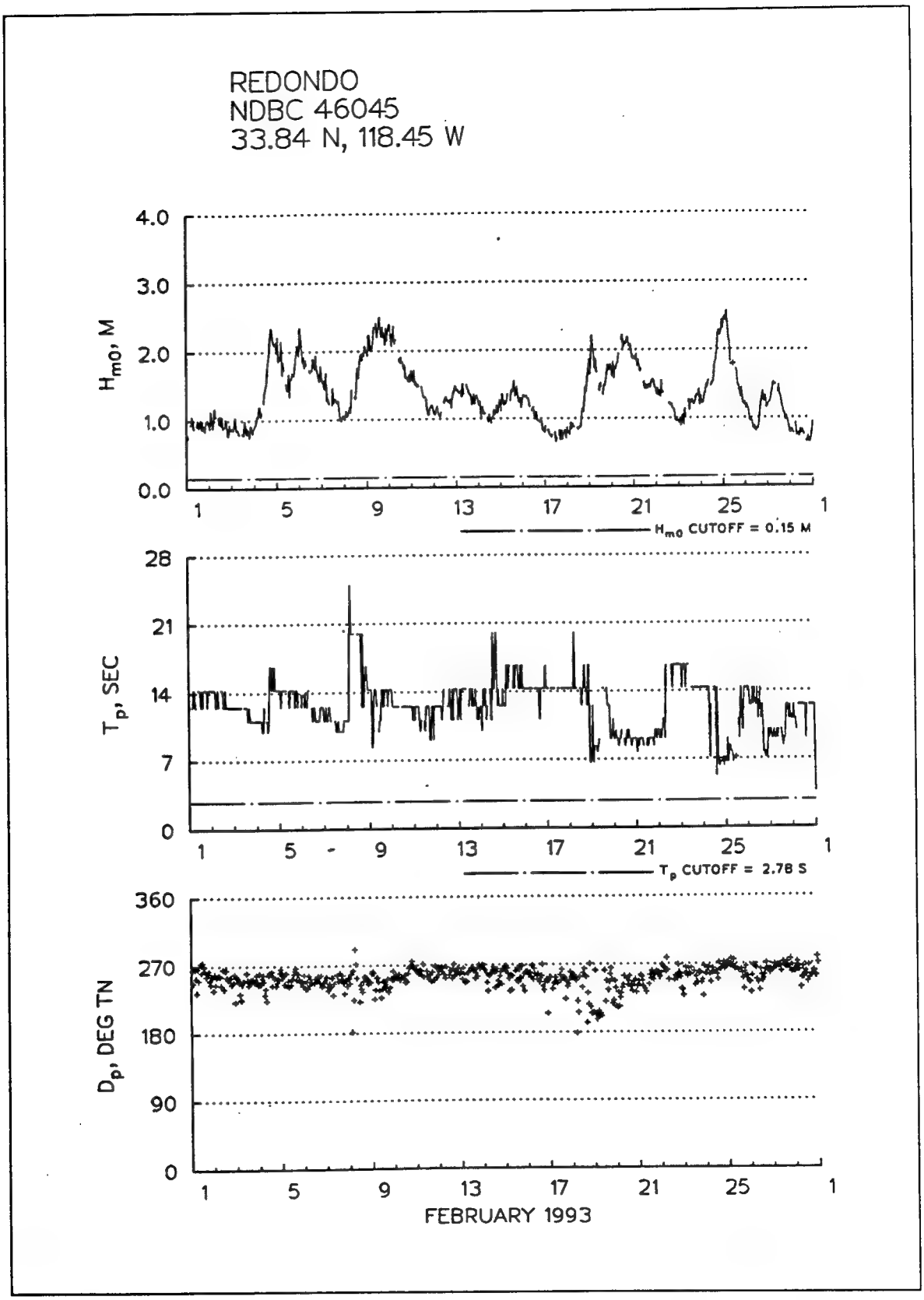

Figure F4. Time series plot for Redondo gage (NDBC 46045), February 1993, first deployment

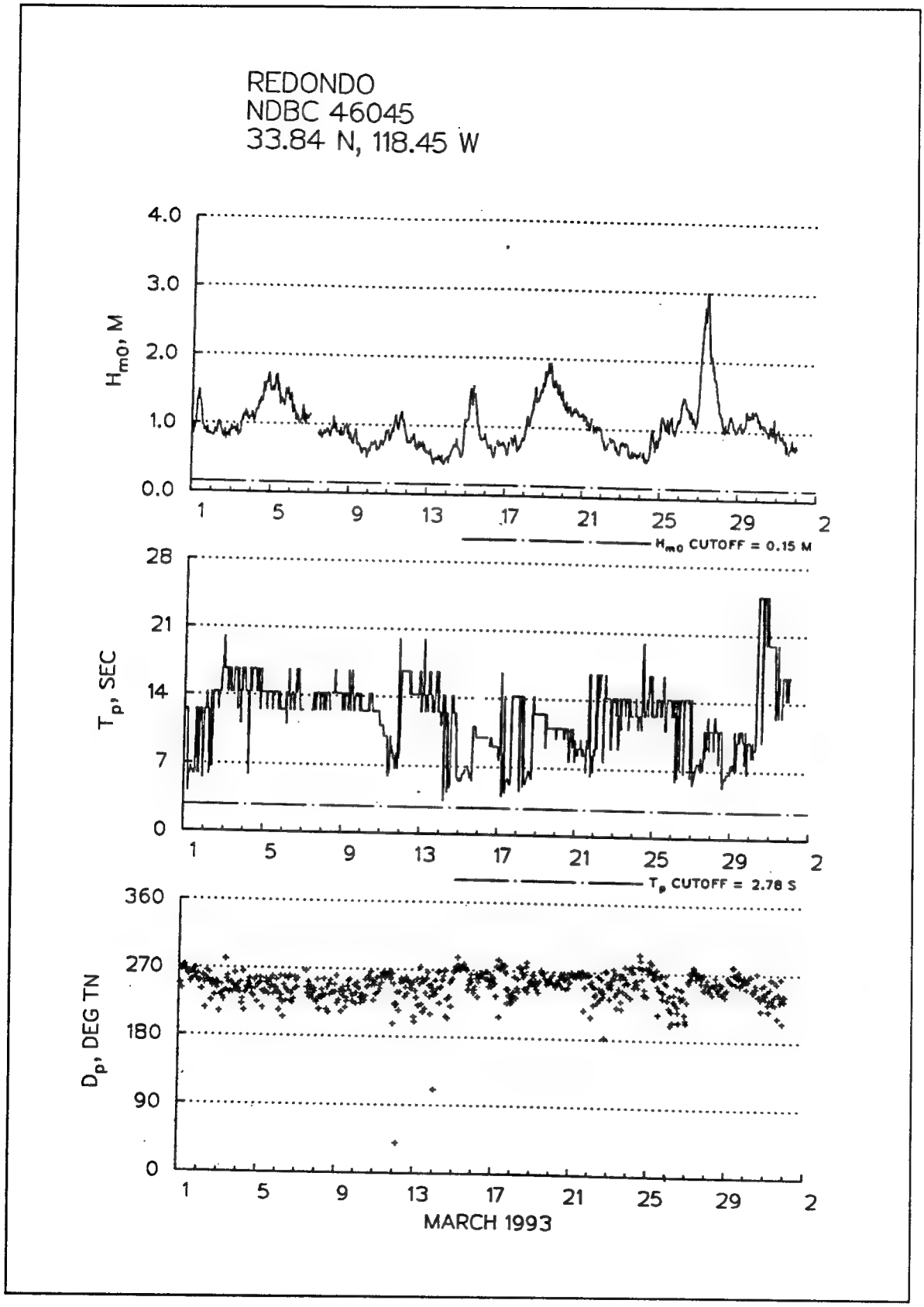

Figure F5. Time series plot for Redondo gage (NDBC 46045), March 1993, first deployment

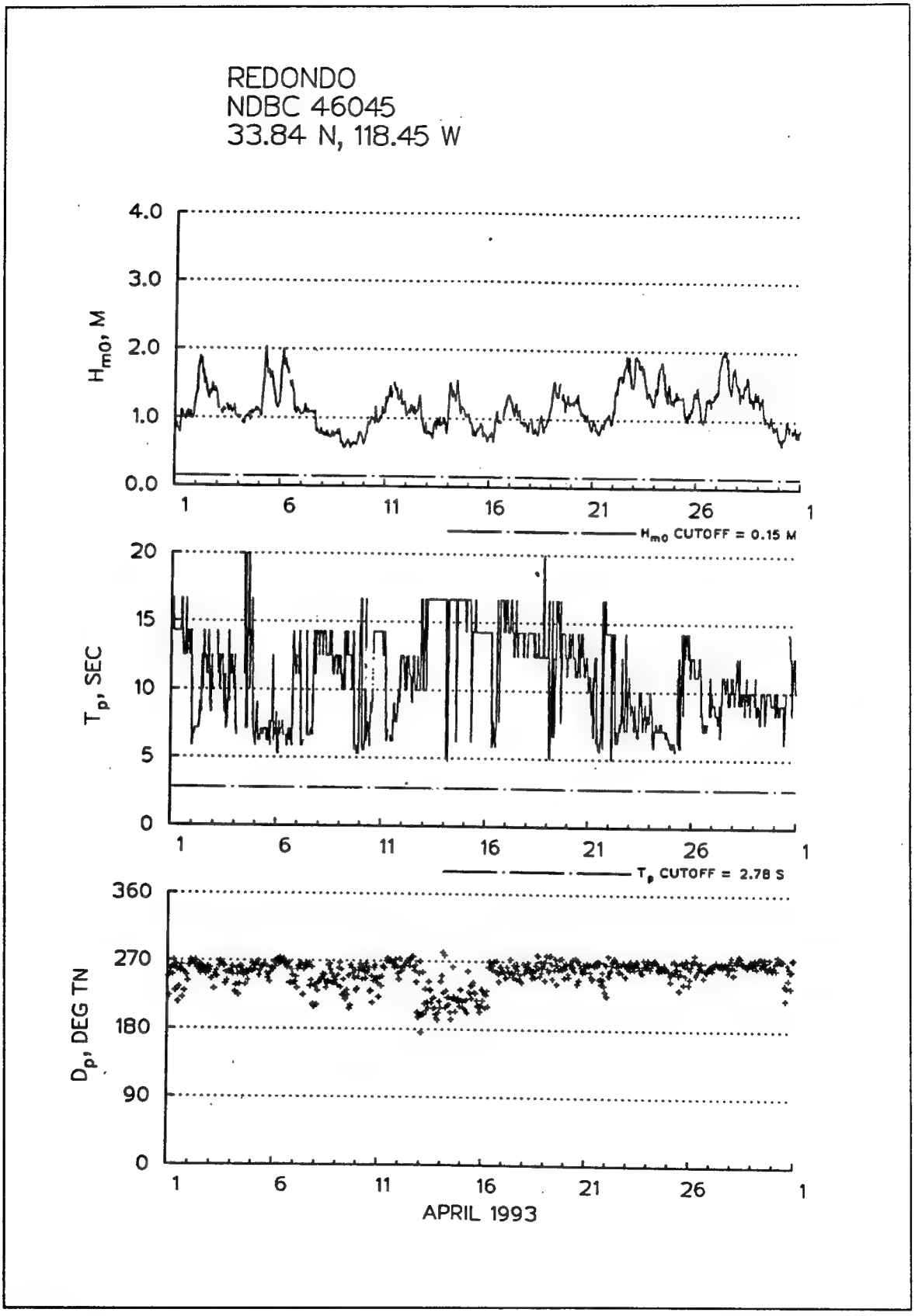

Figure F6. Time series plot for Redondo gage (NDBC 46045), April 1993, first deployment

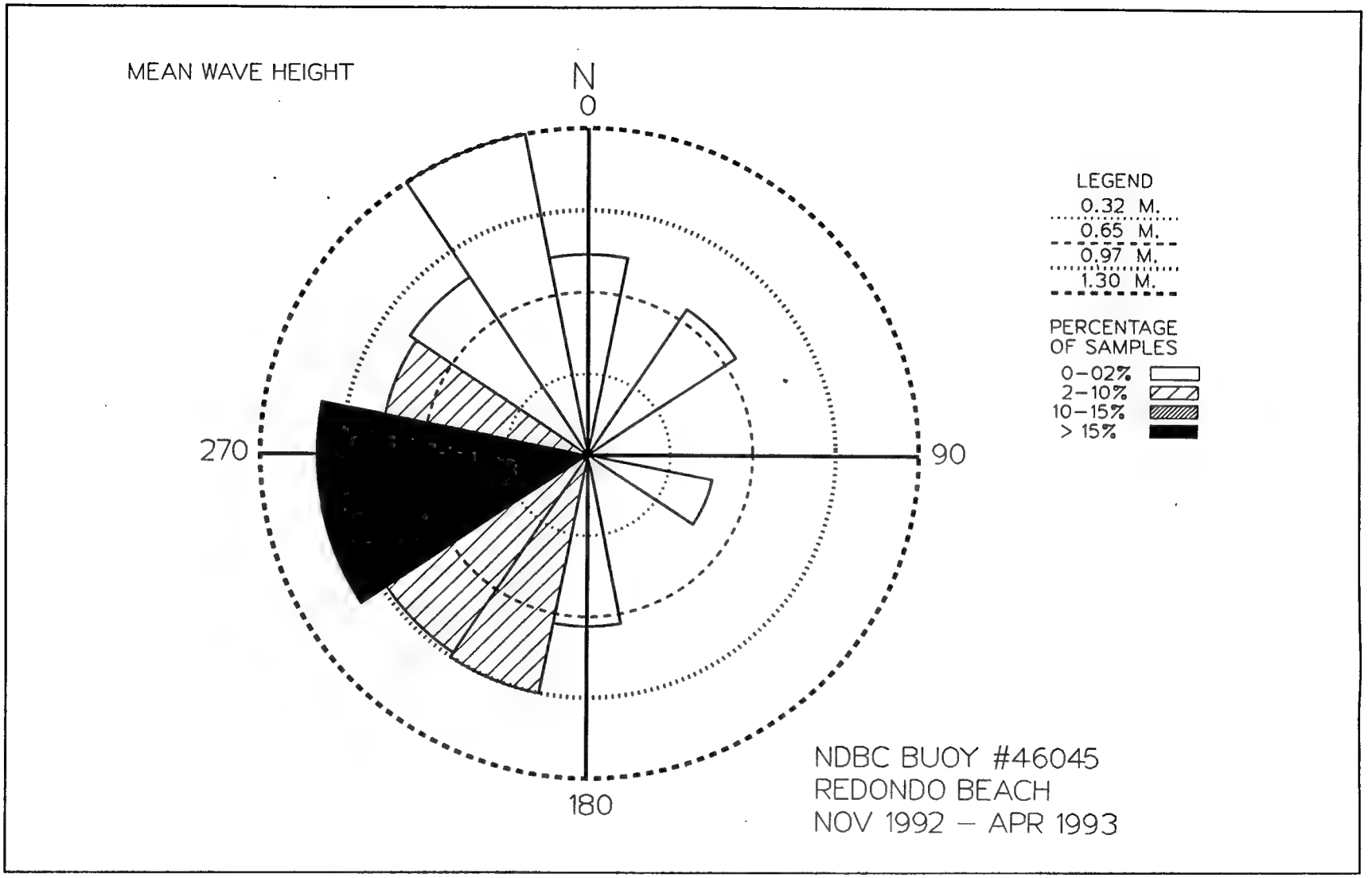

Figure F7. Wave rose plot for Redondo gage (NDBC 46045), first deployment

Table F1
Mean/Max Values for Redondo (NDBC 46045)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46045 (33.84N 118.45W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	.	0.6	1.0	0.8
1993	1.1	1.4	1.0	1.3	.	.	.	.	.	.	.	.	1.2
MEAN	1.1	1.4	1.0	1.3	.	.	.	.	.	.	0.6	1.0	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46045 (33.84N 118.45W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	.	1.7	2.6
1993	2.9	2.6	3.0	2.6	.	.	.	.	.	.	.	.

STATISTICS FOR NDBC BUOY 46045 (33.84N 118.45W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	1.1
THE MEAN PEAK WAVE PERIOD (SECONDS)=	11.2
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	270.0
THE STANDARD DEVIATION OF Hm0(METERS)=	0.5
THE STANDARD DEVIATION OF TP(SECONDS)=	3.4
THE LARGEST Hm0(METERS)=	3.0
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	7.7
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	279.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93032707

Table F2
Percent Occurrence for Redondo (NDBC 46045)
First Deployment

BUOY STATION 46045 33.84 N 118.45 W FOR ALL DIRECTIONS
NOVEMBER 1992 - APRIL 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	<6.9	6.9-8.0	8.1-8.7	8.8-9.5	9.6-10.5	10.6-11.7	11.8-13.3	13.4-15.3	15.4-18.1	18.2-LONGER	
0.0-0.9	544	223	201	274	399	512	909	1331	291	36	4720
1.0-1.9	664	394	208	370	392	549	845	826	306	98	4652
2.0-2.9	90	125	31	34	24	58	142	102	7	.	613
3.0-3.9	.	2	.	.	.	.	.	.	.	.	2
4.0-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0-5.9	.	.	.	.	.	.	.	.	.	.	0
6.0-6.9	.	.	.	.	.	.	.	.	.	.	0
7.0-7.9	.	.	.	.	.	.	.	.	.	.	0
8.0-8.9	.	.	.	.	.	.	.	.	.	.	0
9.0-9.9	.	.	.	.	.	.	.	.	.	.	0
10.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	1298	744	440	678	815	1119	1896	2259	604	134	

MEAN Hm0(M)= 1.1 LARGEST Hm0(M)= 3.0 MEAN TP(SEC)= 11.2 TOTAL CASES= 4079.

Appendix G
Catalina Ridge Site, First Deployment

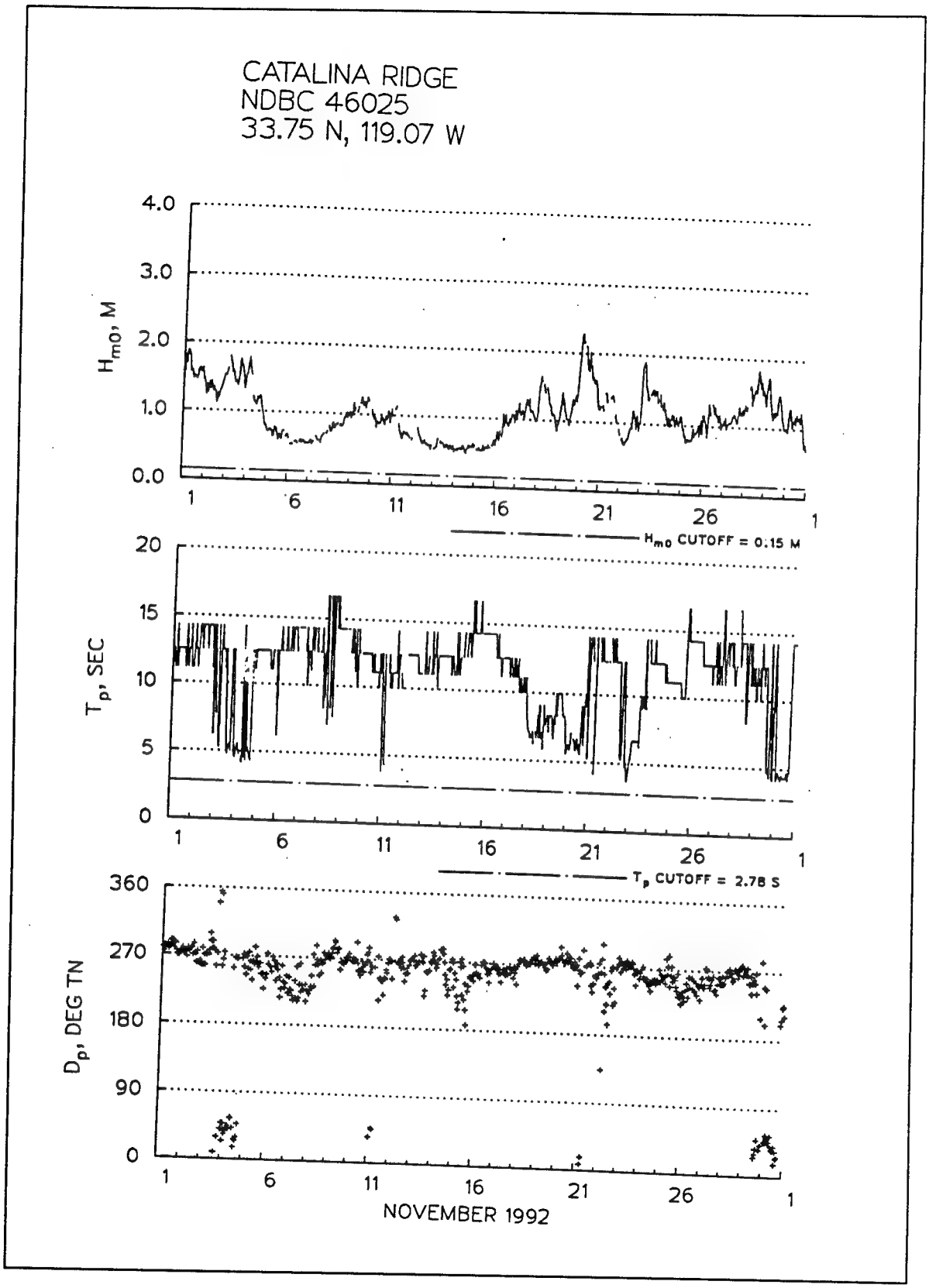

Figure G1. Time series plot for Catalina Ridge gage (46025), November 1992, first deployment

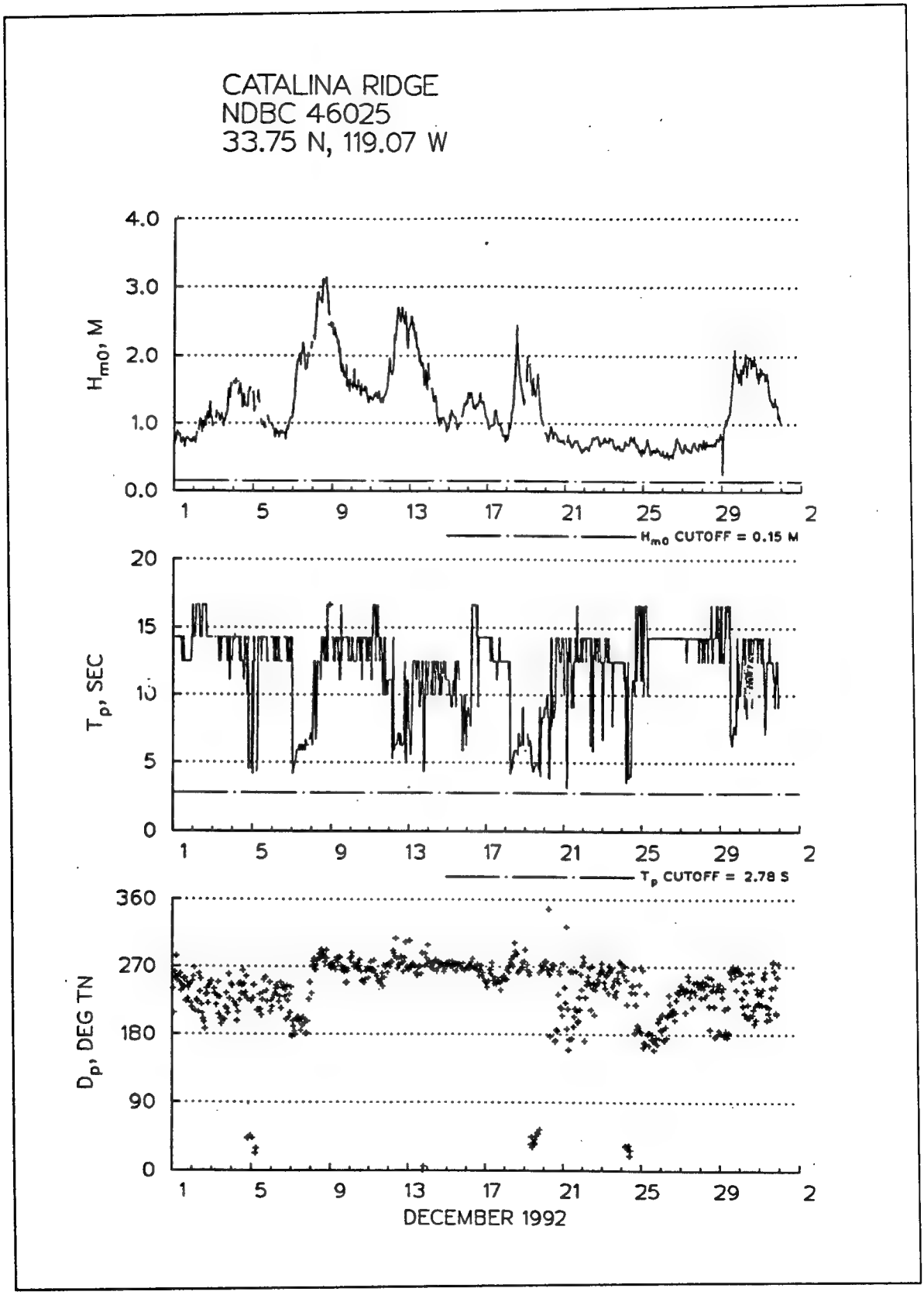

Figure G2. Time series plot for Catalina Ridge gage (46025), December 1992, first deployment

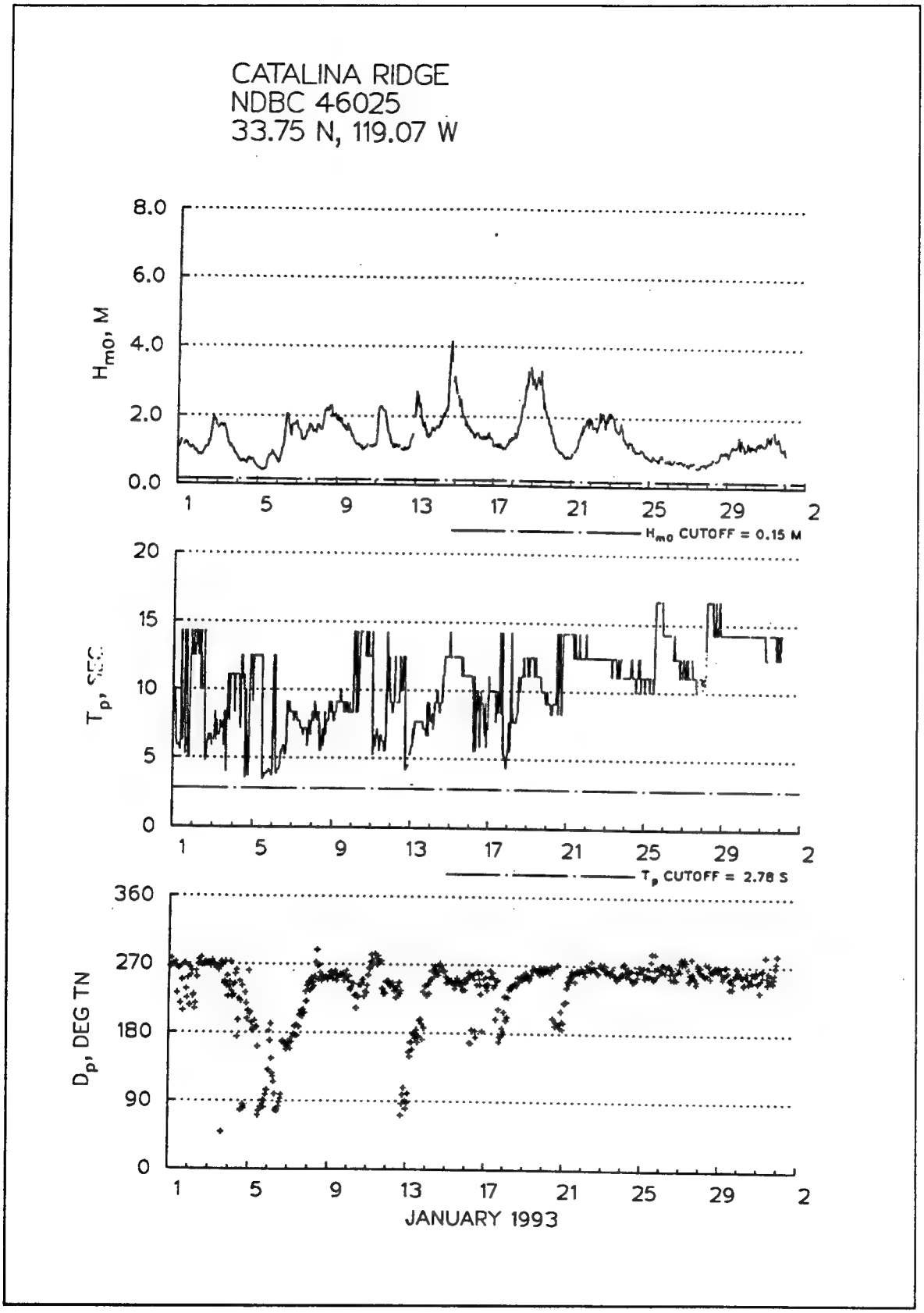

Figure G3. Time series plot for Catalina Ridge gage (46025), January 1993, first deployment

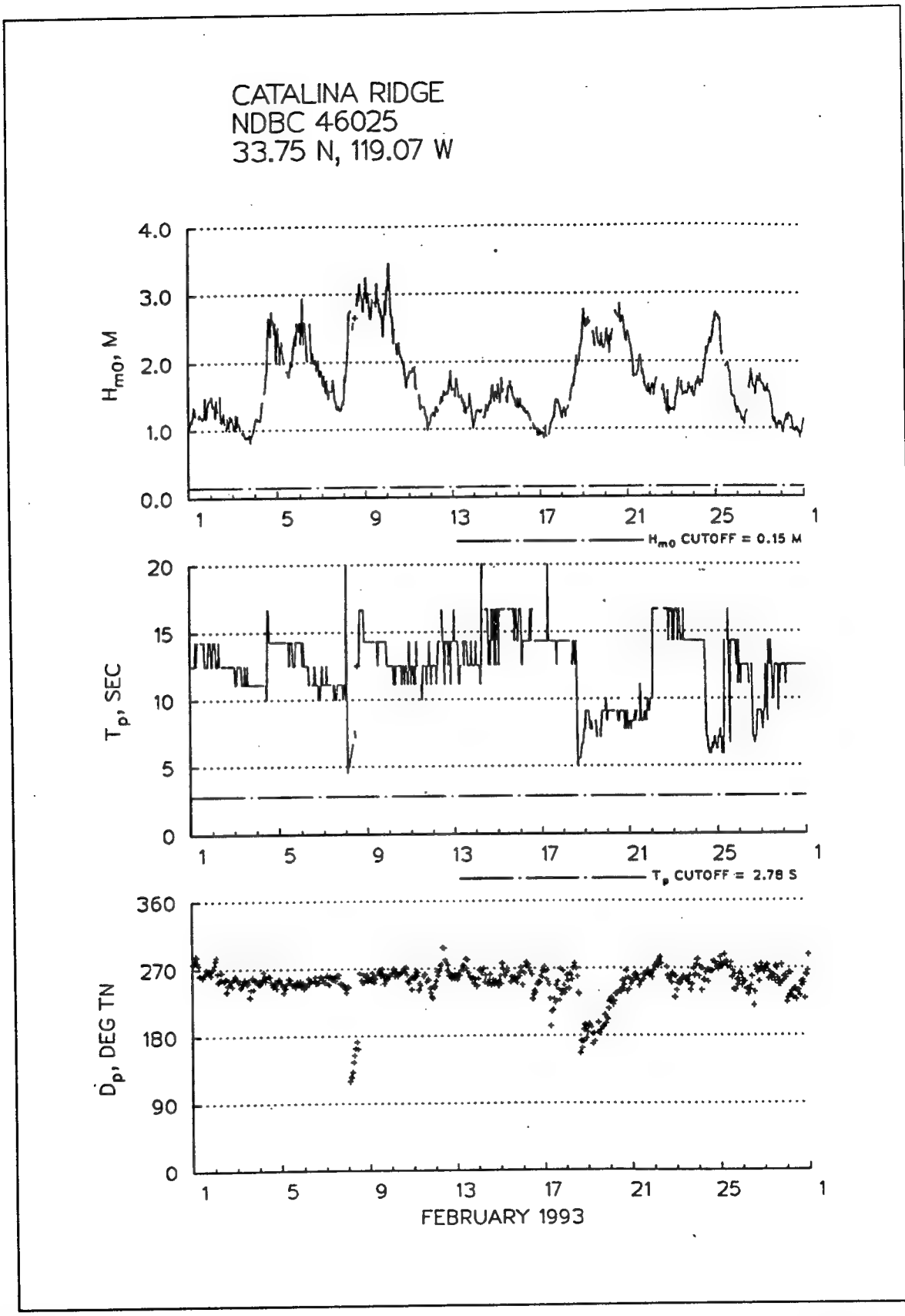

Figure G4. Time series plot for Catalina Ridge gage (46025), February 1993, first deployment

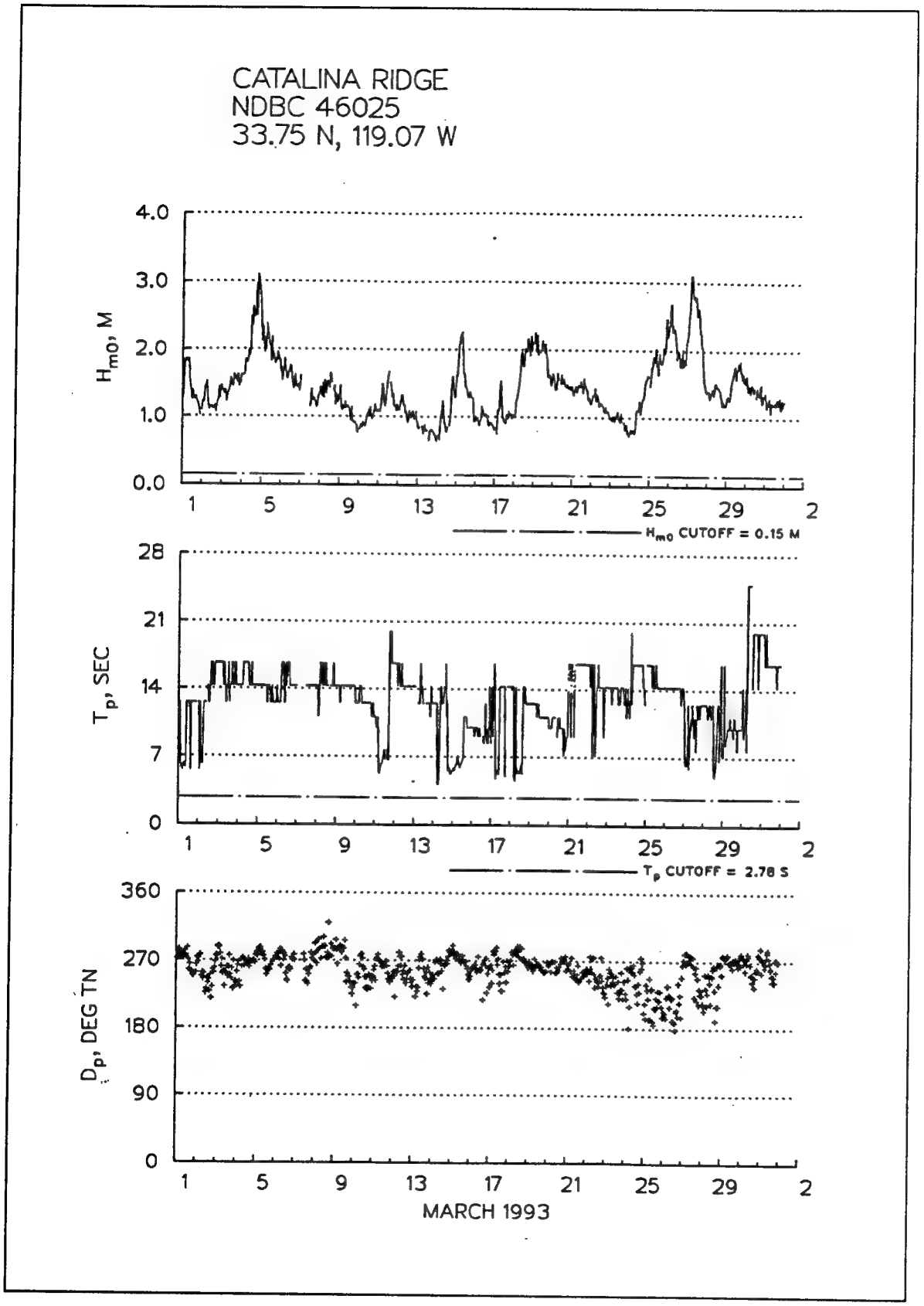

Figure G5. Time series plot for Catalina Ridge gage (46025), March 1993, first deployment

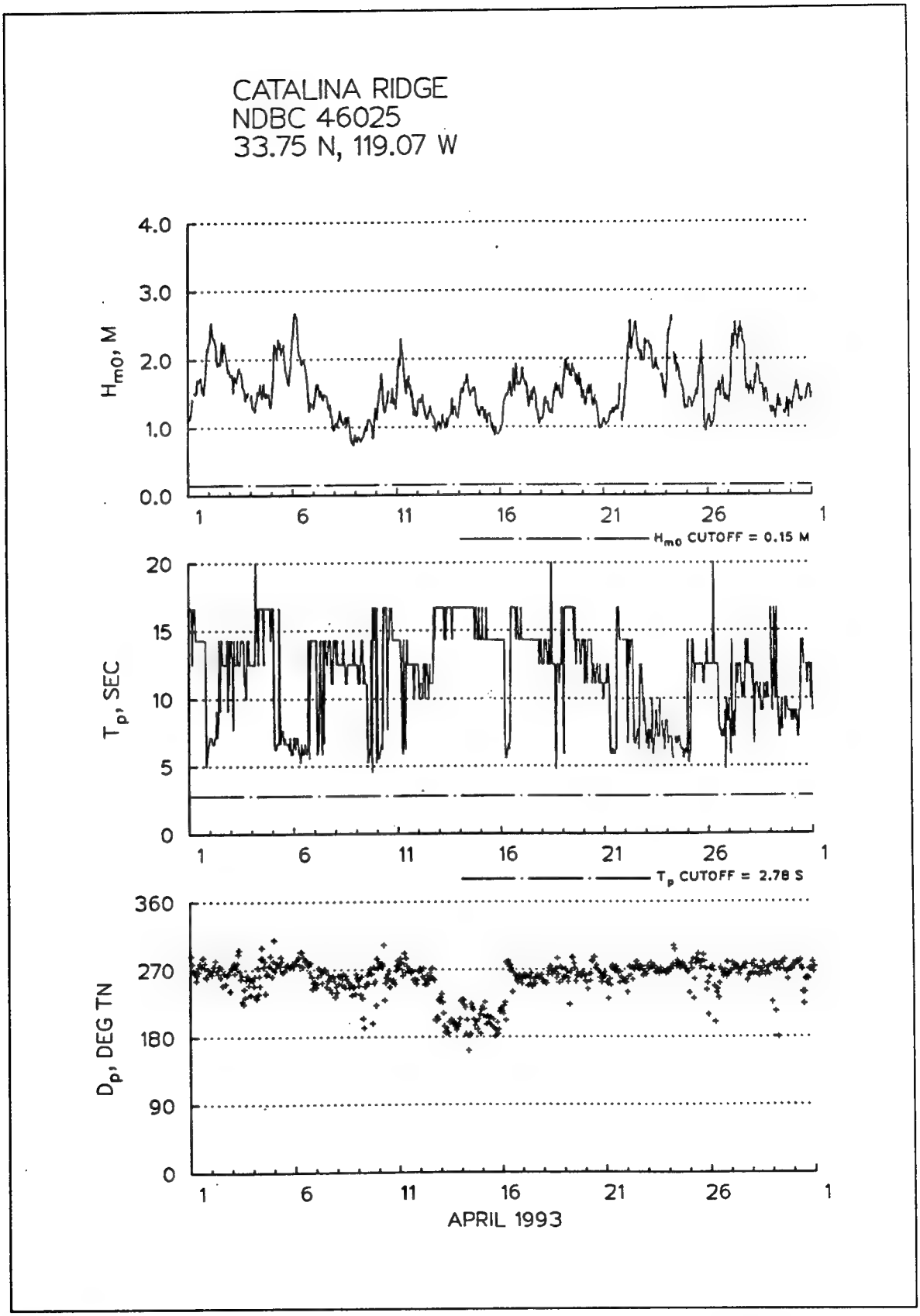

Figure G6. Time series plot for Redondo gage (46045), April 1993, first deployment

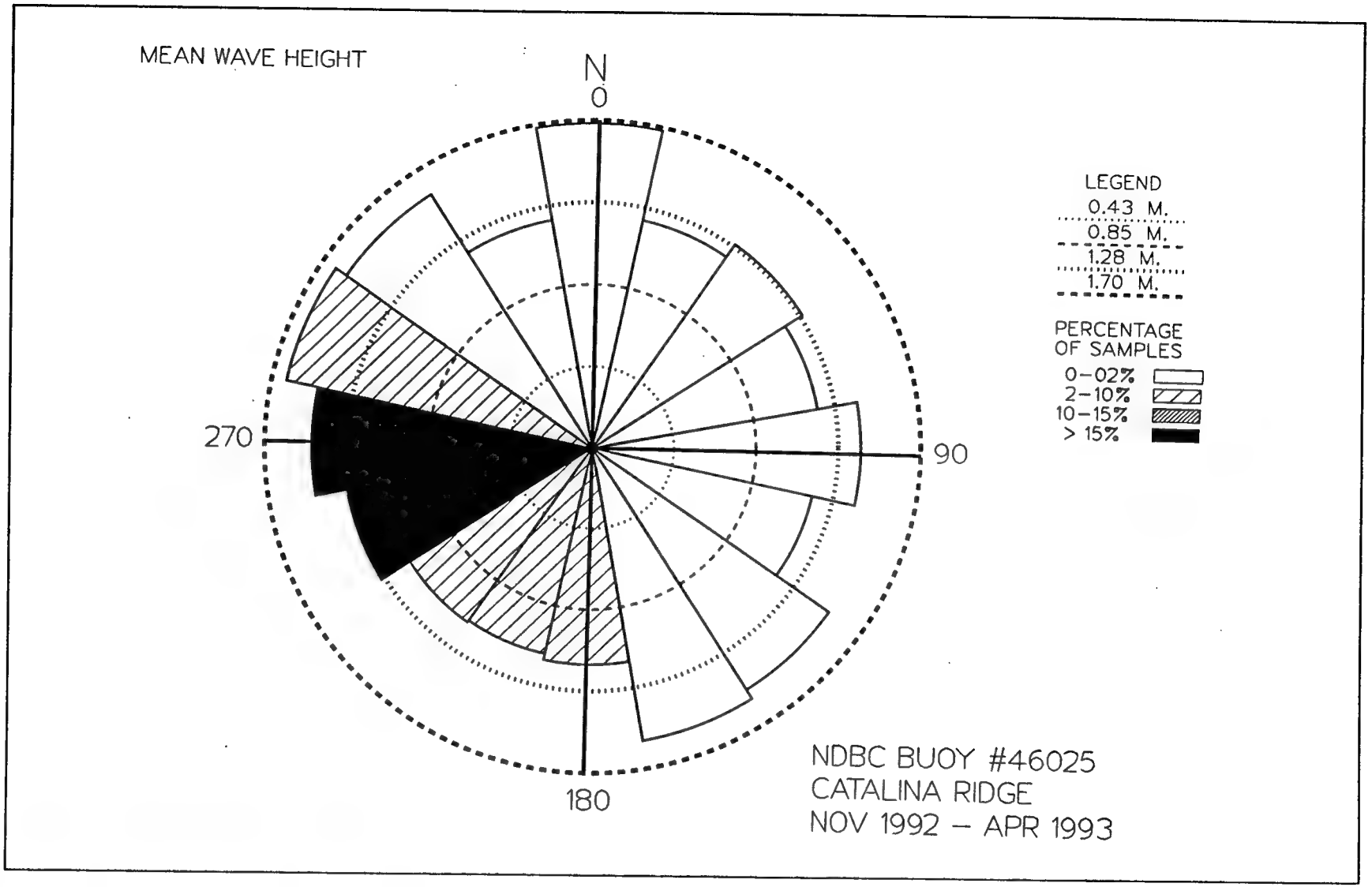

Figure G7. Wave rose plot for Catalina Ridge gage (NDBC 46025), first deployment

Table G1
Mean/Max Values for Catalina Ridge (NDBC 46025)
First Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46025 (33.75N 119.07W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1992	.	.	.	.	.	.	.	.	.	1.1	1.1	1.2	1.1
1993	1.4	1.7	1.4	1.5	.	.	.	.	.	.	.	.	1.5
MEAN	1.4	1.7	1.4	1.5	.	.	.	.	.	1.1	1.1	1.2	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46025 (33.75N 119.07W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1992	.	.	.	.	.	.	.	.	.	2.2	2.3	3.2
1993	4.2	3.5	3.1	2.7	.	.	.	.	.	.	.	.

STATISTICS FOR NDBC BUOY 46025 (33.75N 119.07W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	1.3
THE MEAN PEAK WAVE PERIOD (SECONDS)=	11.9
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	270.0
THE STANDARD DEVIATION OF Hm0(METERS)=	0.5
THE STANDARD DEVIATION OF TP(SECONDS)=	3.2
THE LARGEST Hm0(METERS)=	4.2
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	12.5
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	263.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93011418

Table G2
Percent Occurrence for Catalina Ridge (NDBC 46025)
First Deployment

BUOY STATION 46025 33.75 N 119.07 W FOR ALL DIRECTIONS
NOVEMBER 1992 - APRIL 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METRES)	PEAK PERIOD(SECONDS)										TOTAL
	<6.9	6.9-8.0	8.1-8.7	8.8-9.5	9.6-10.5	10.6-11.7	11.8-13.3	13.4-15.3	15.4-18.1	18.2-LONGER	
0.0-0.9	116	28	44	57	120	357	696	834	151	4	2407
1.0-1.9	722	251	159	246	328	647	1457	1720	687	65	6282
2.0-2.9	289	151	53	79	30	91	240	244	26	.	1203
3.0-3.9	2	2	.	.	.	14	34	28	8	.	88
4.0-4.9	.	.	.	.	.	.	4	.	.	.	4
5.0-5.9	.	.	.	.	.	.	.	.	.	.	0
6.0-6.9	.	.	.	.	.	.	.	.	.	.	0
7.0-7.9	.	.	.	.	.	.	.	.	.	.	0
8.0-8.9	.	.	.	.	.	.	.	.	.	.	0
9.0-9.9	.	.	.	.	.	.	.	.	.	.	0
10.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	1129	432	256	382	478	1109	2431	2826	872	69	

MEAN Hm0(M)= 1.3 LARGEST Hm0(M)= 4.2 MEAN TP(SEC)= 11.9 TOTAL CASES= 4899.

Appendix H
North Breakwater Site, Second Deployment

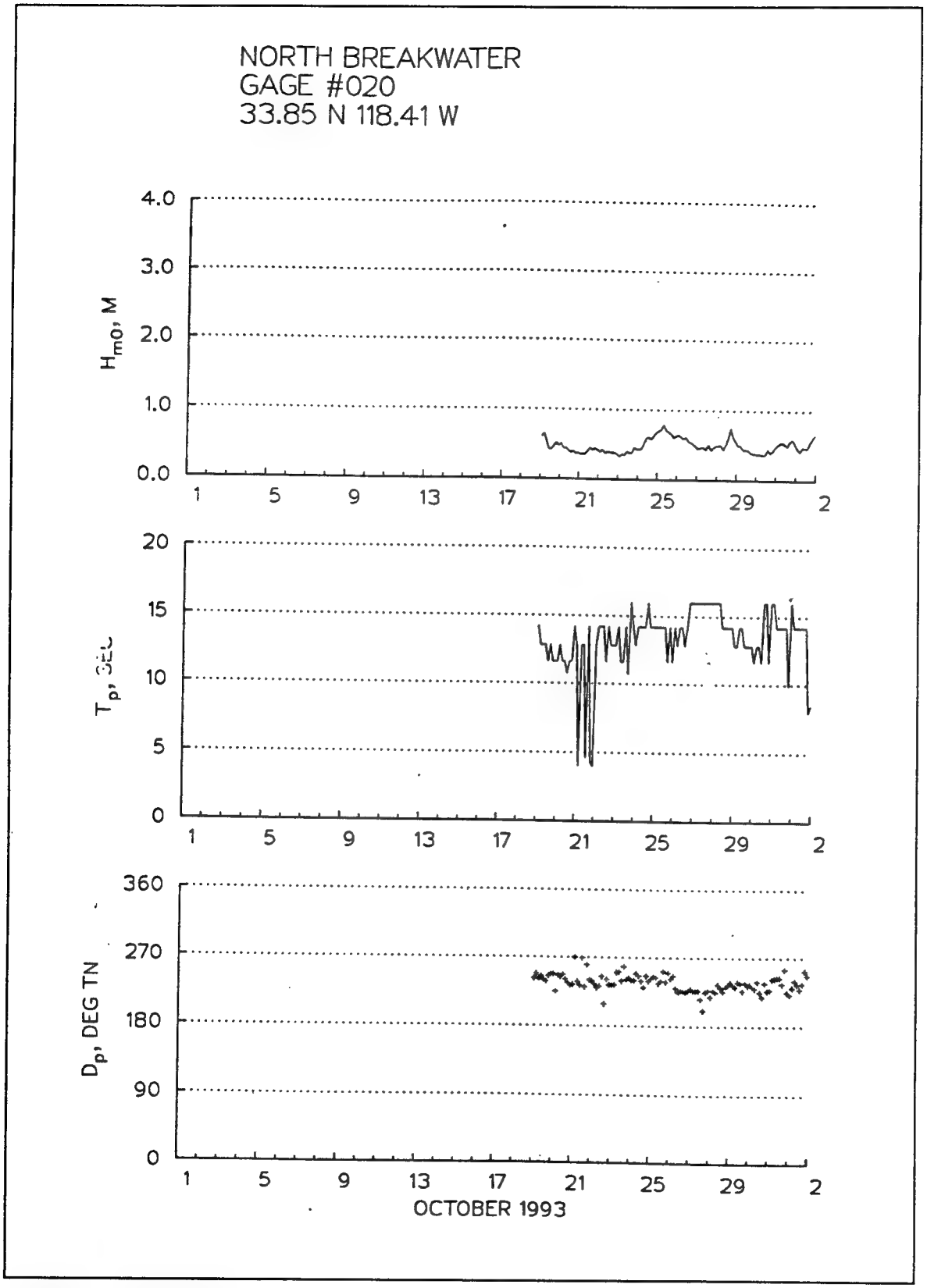

Figure H1. Time series plot for North Breakwater gage (020), October 1993, second deployment

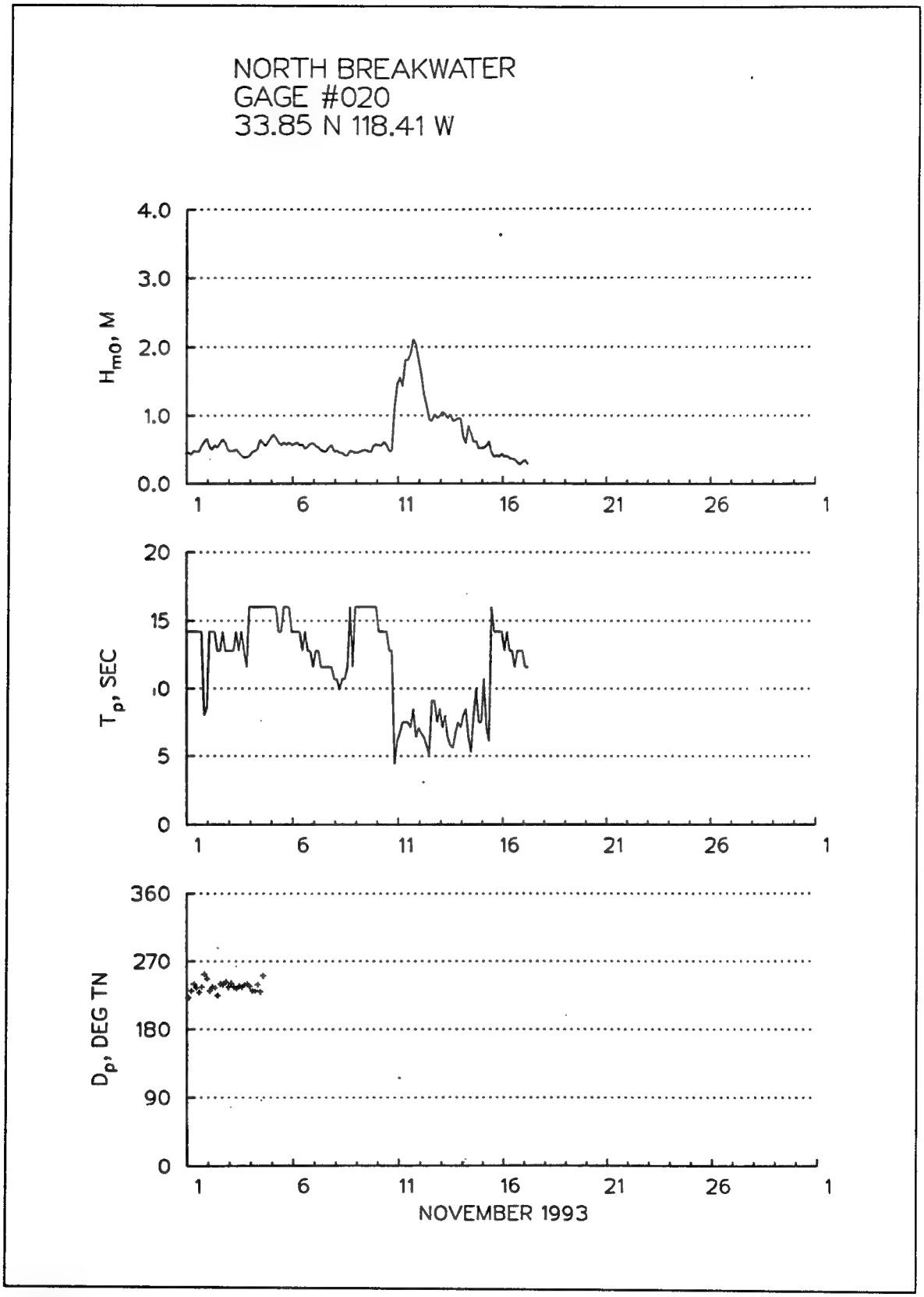

Figure H2. Time series plot for North Breakwater gage (020), November 1993, second deployment

Table H1
Mean/Max Values for North Breakwater (020)
Second Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NORTH BREAKWATER (33.85N 118.41W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1993	.	.	.	.	.	.	.	.	.	0.5	0.7	.	0.6
MEAN	.	.	.	.	.	.	.	.	.	0.5	0.7	.	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NORTH BREAKWATER (33.85N 118.41W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1993	.	.	.	.	.	.	.	.	.	0.8	2.1	.

STATISTICS FOR NORTH BREAKWATER (33.85N 118.41W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.6
THE MEAN PEAK WAVE PERIOD (SECONDS)=	12.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.3
THE STANDARD DEVIATION OF TP(SECONDS)=	3.1
THE LARGEST Hm0(METERS)=	2.1
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	8.5
THE DATE OF LARGEST Hm0 OCCURRENCE IS	93111117

Table H2
Percent Occurrence for North Breakwater (020)
Second Deployment

NORTH BREAKWATER 33.85N 118.41W IRRESPECTIVE OF DIRECTION

OCTOBER 1993 - NOVEMBER 1993
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	128	42	.	42	256	897	1282	982	1068	.	4697
0.5-0.9	.	85	470	384	42	299	598	1837	854	.	4569
1.0-1.4	42	.	256	85	.	.	.	.	.	.	383
1.5-1.9	.	.	256	.	.	.	.	.	.	.	256
2.0-2.4	.	.	42	42	.	.	.	.	.	.	84
2.5-2.9	.	.	.	.	.	.	.	.	.	.	0
3.0-3.4	.	.	.	.	.	.	.	.	.	.	0
3.5-3.9	.	.	.	.	.	.	.	.	.	.	0
4.0-4.4	.	.	.	.	.	.	.	.	.	.	0
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	170	127	1024	553	298	1196	1880	2819	1922	0	

MEAN Hm0(M)= 0.6 LARGEST Hm0(M)= 2.1 MEAN TP(SEC)= 12.5 TOTAL CASES= 234.

Appendix I
South Breakwater Site, Second Deployment

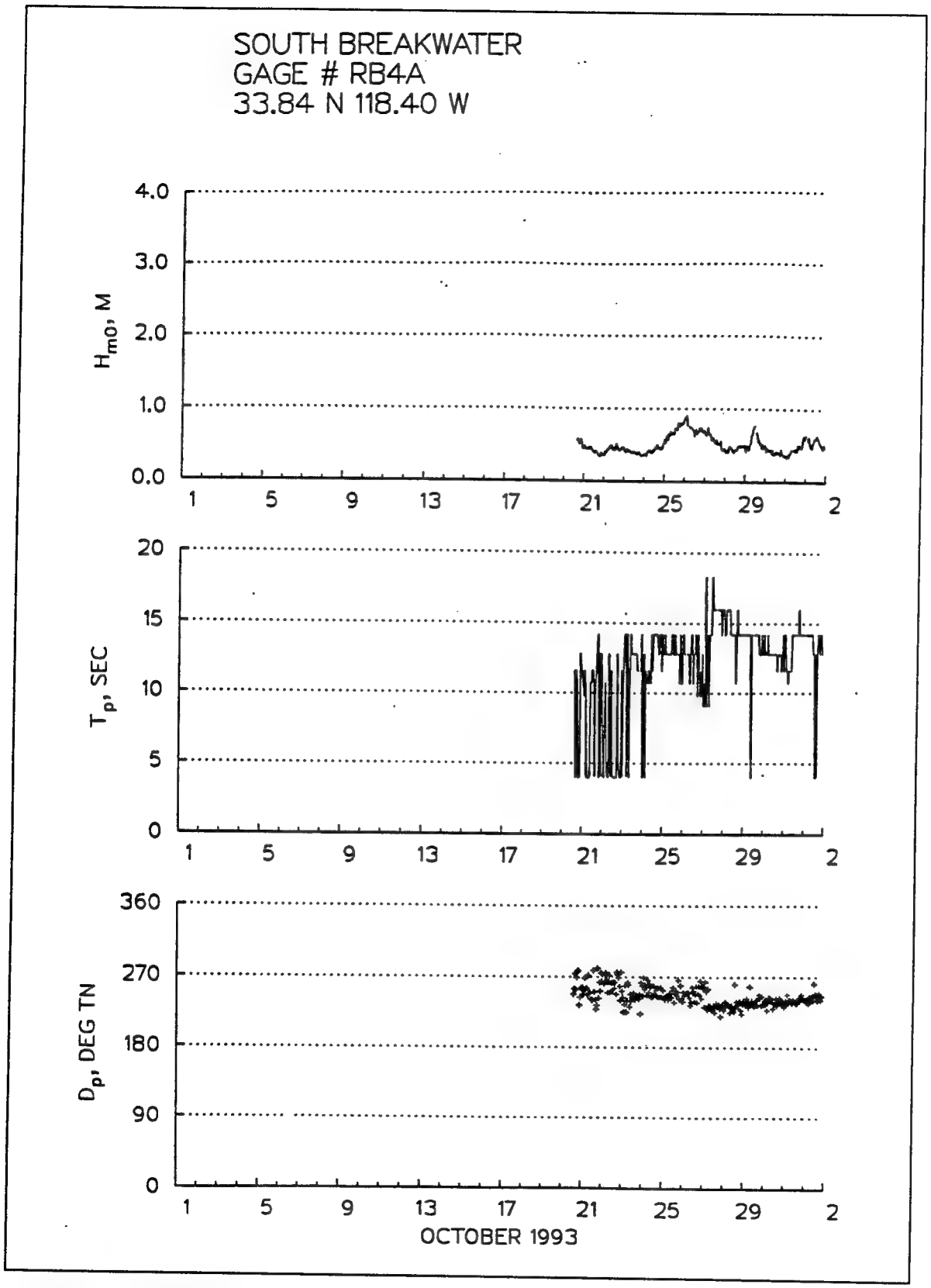

Figure I1. Time series plot for South Breakwater gage (RB4A), October 1993, second deployment

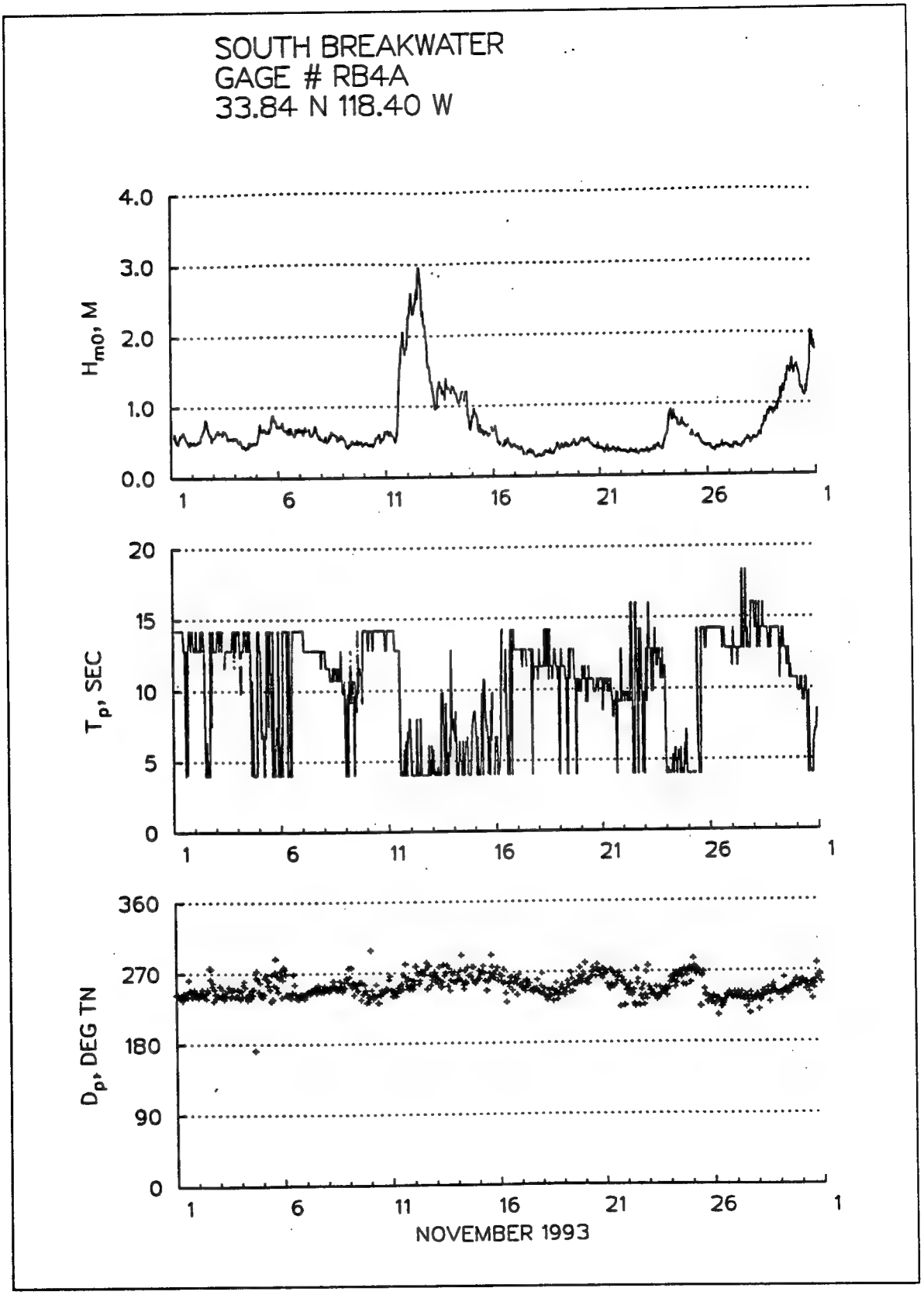

Figure I2. Time series plot for South Breakwater gage (RB4A), November 1993, second deployment

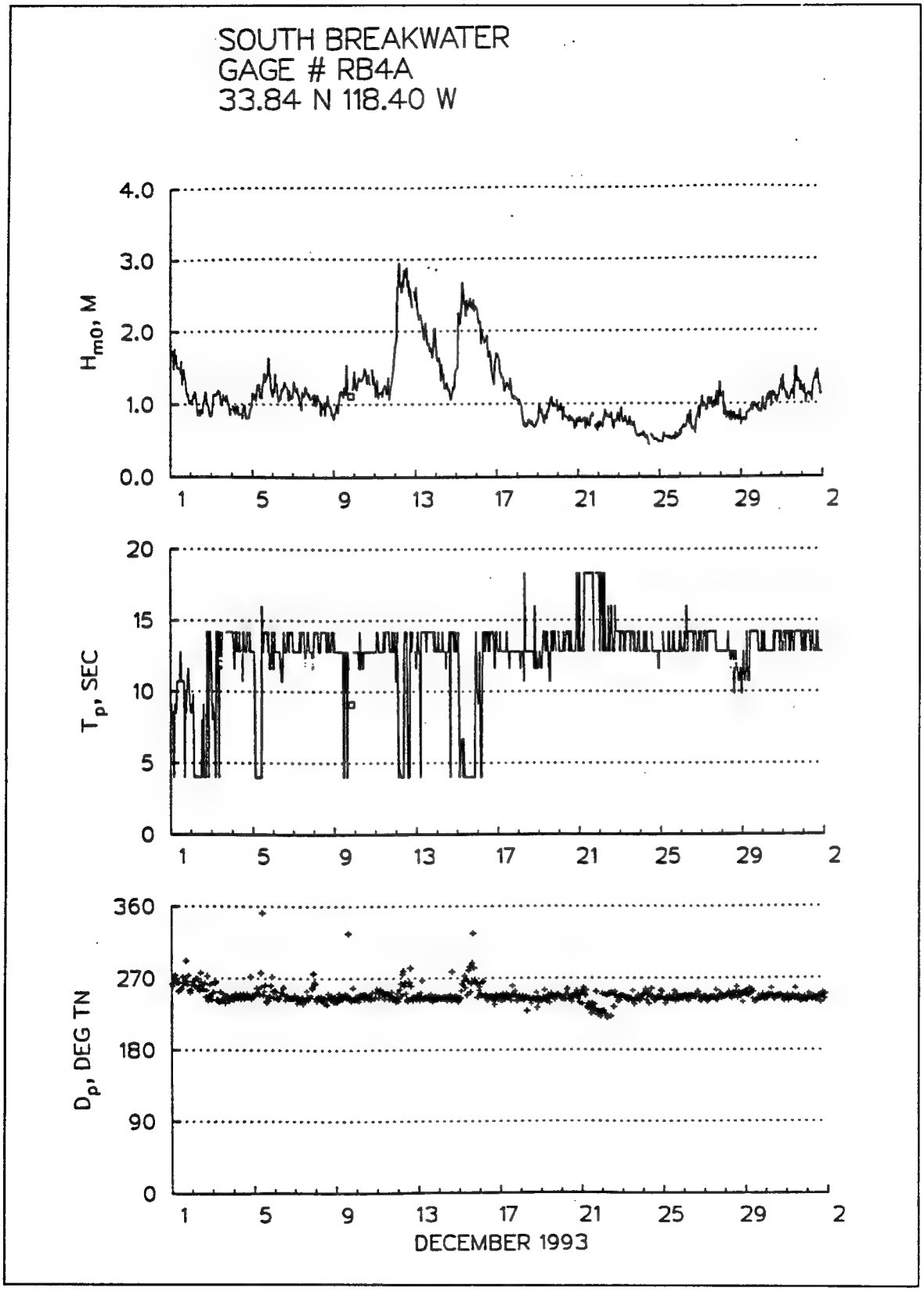

Figure I3. Time series plot for South Breakwater gage (RB4A), December 1993, second deployment

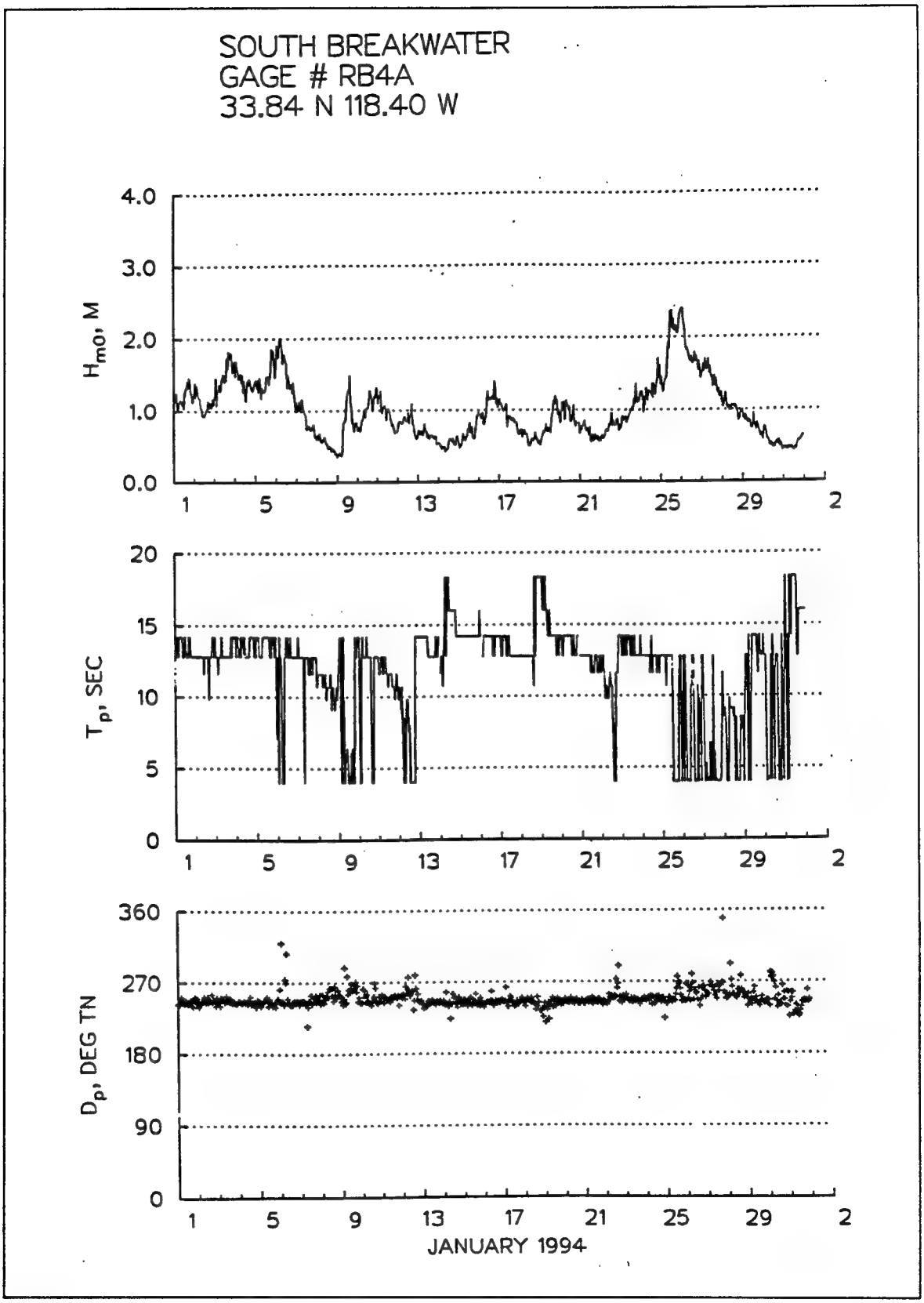

Figure 14. Time series plot for South Breakwater gage (RB4A), January 1994, second deployment

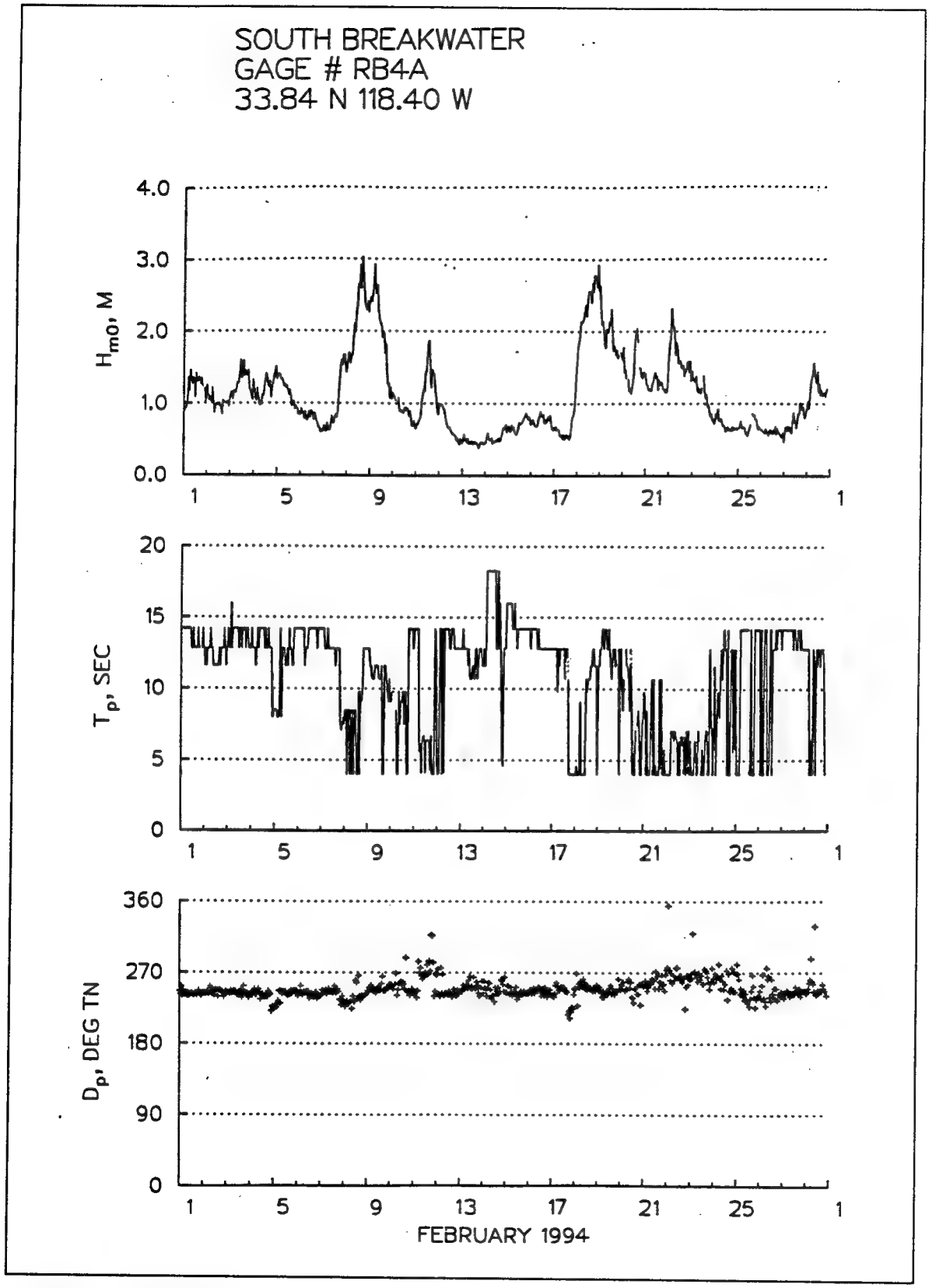

Figure I5. Time series plot for South Breakwater gage (RB4A), February 1994, second deployment

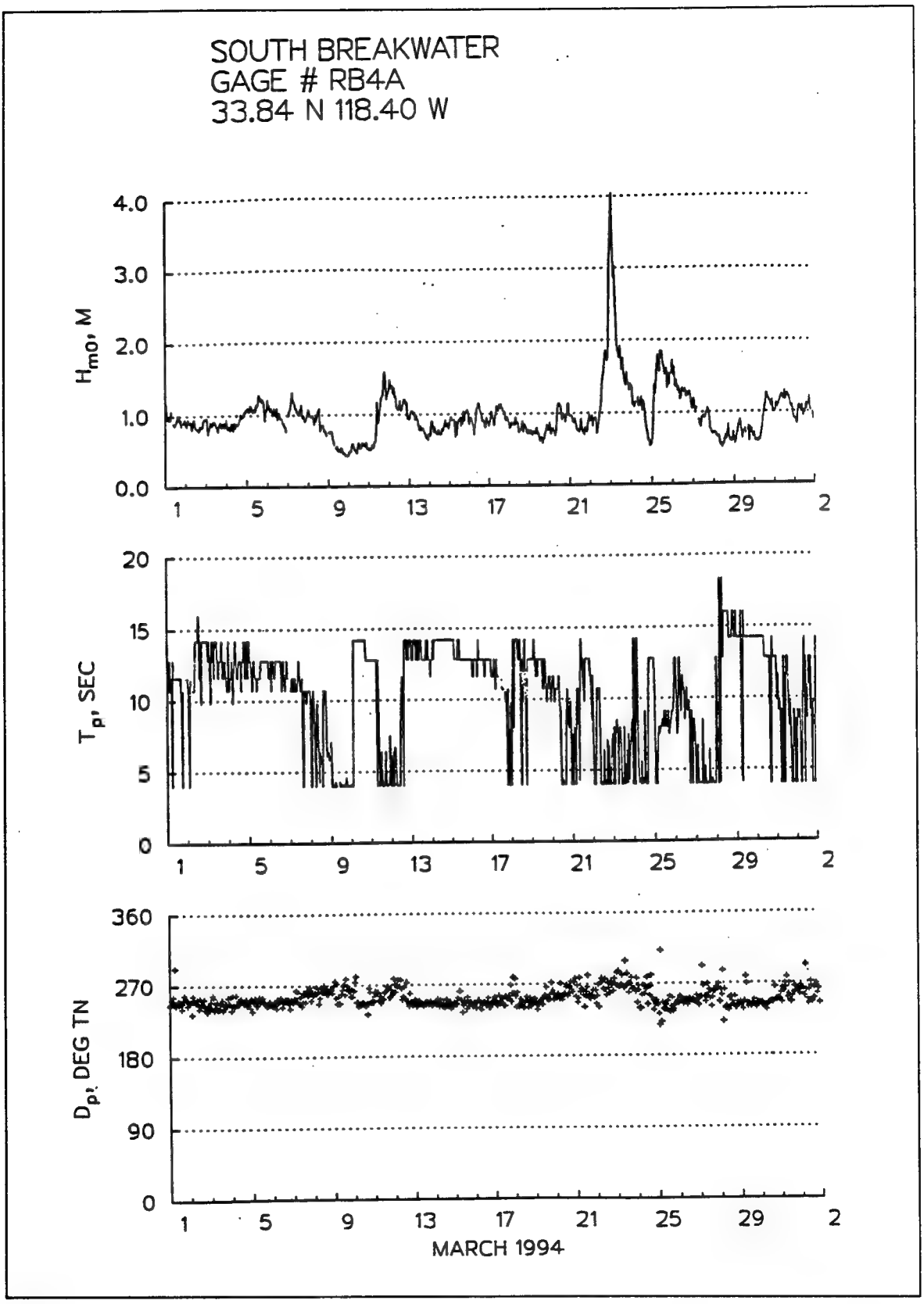

Figure 16. Time series plot for South Breakwater gage (RB4A), March 1994, second deployment

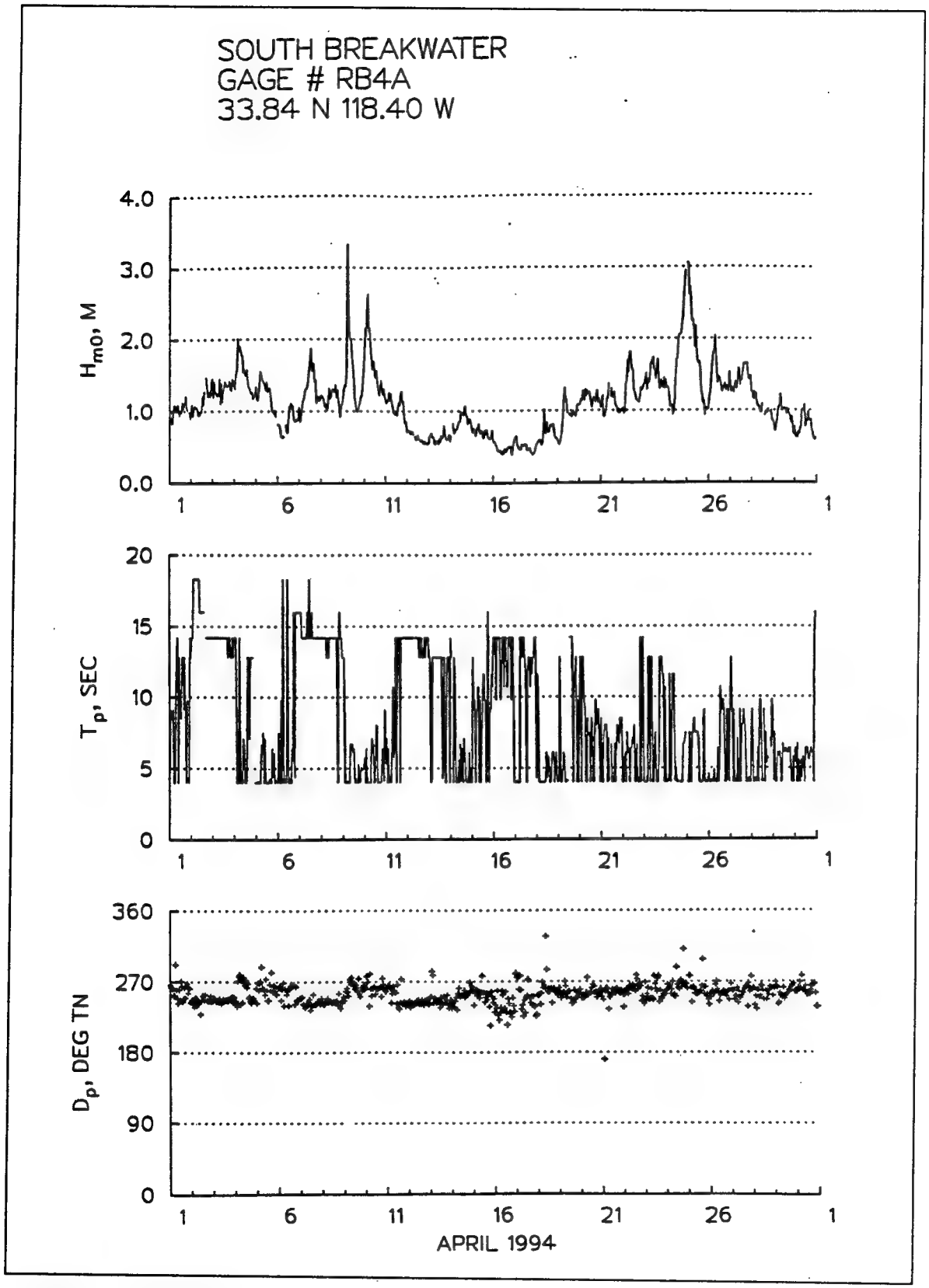

Figure 17. Time series plot for South Breakwater gage (RB4A), April 1994, second deployment

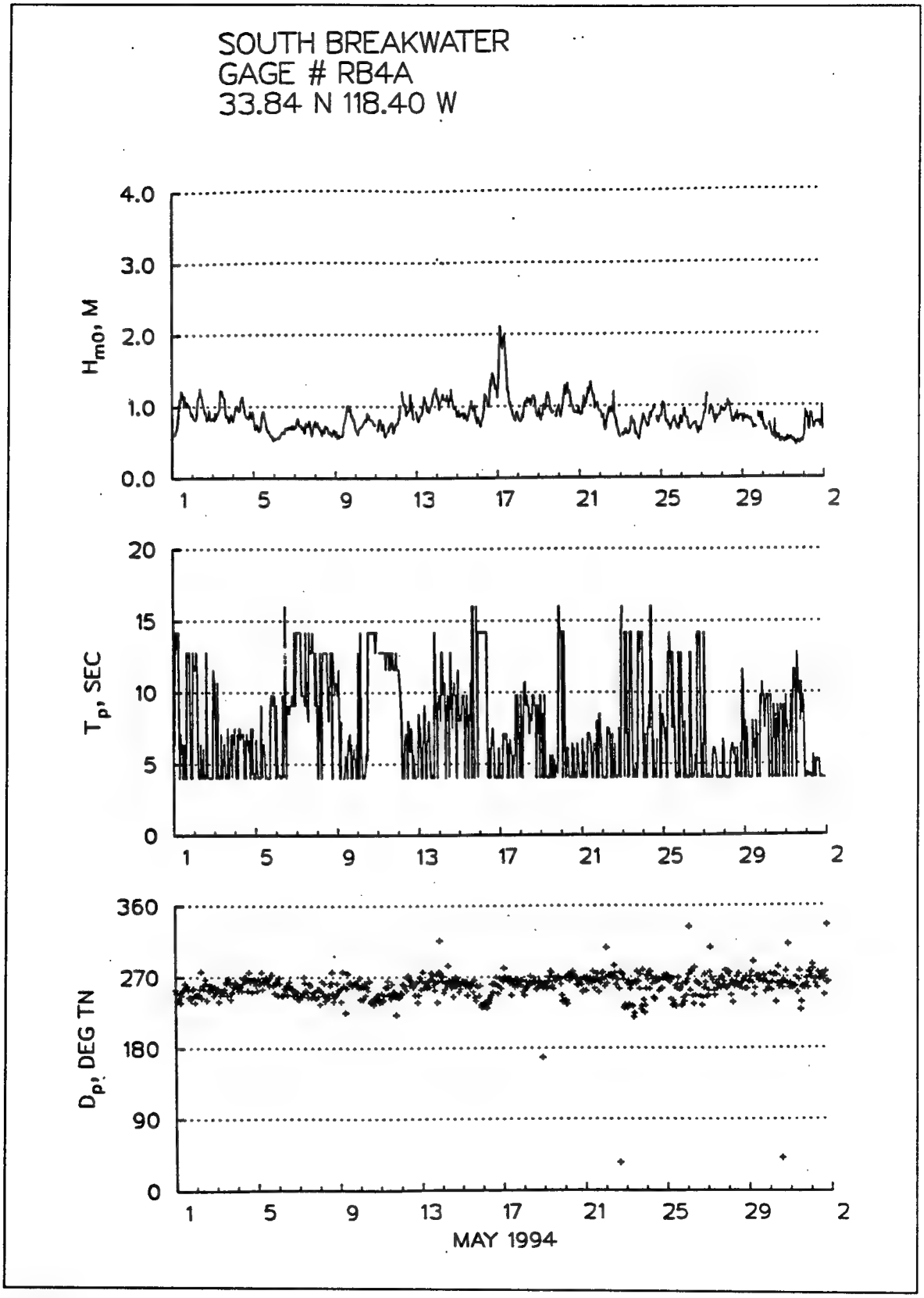

Figure I8. Time series plot for South Breakwater gage (RB4A), May 1994, second deployment

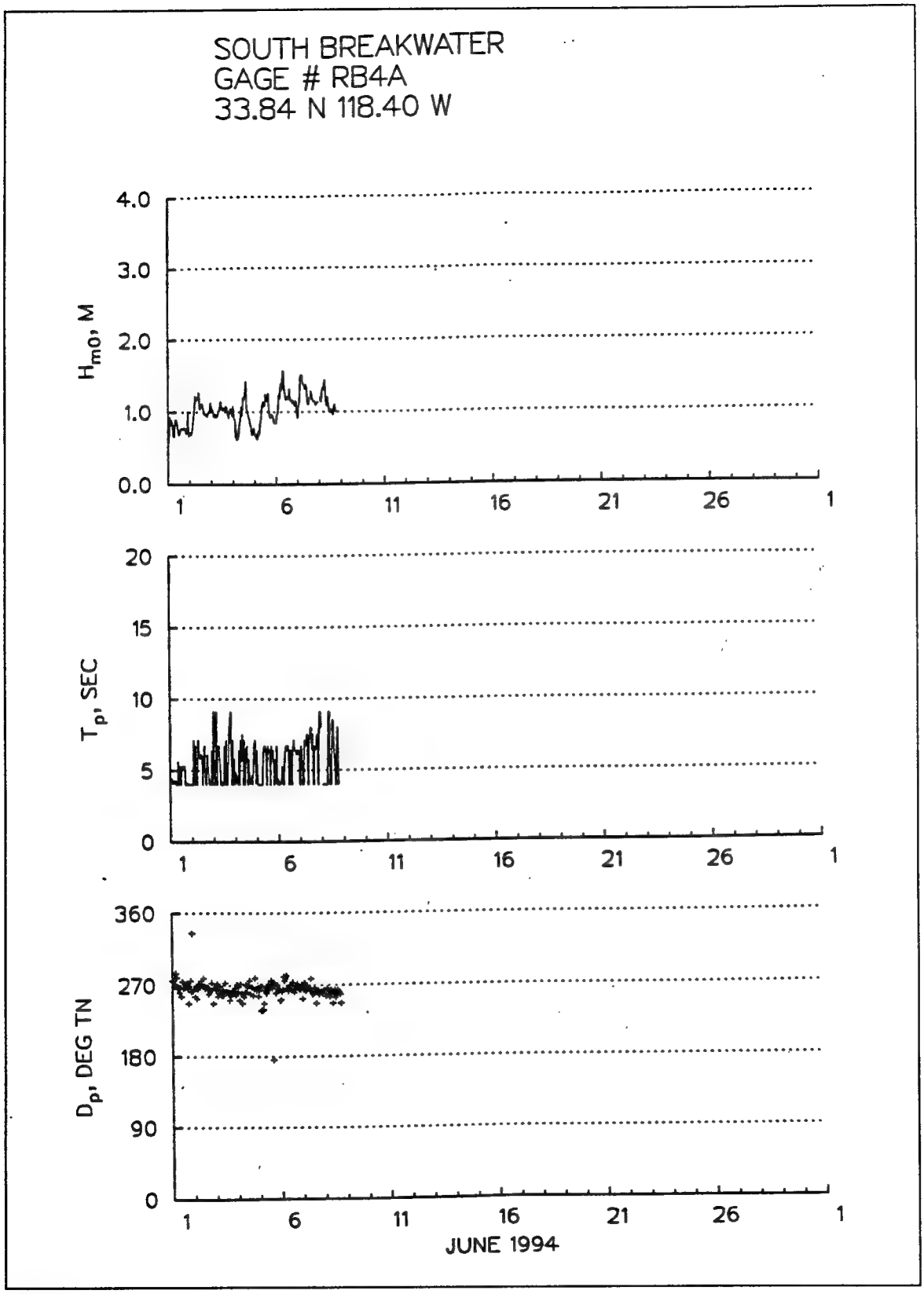

Figure I9. Time series plot for South Breakwater gage (RB4A), June 1994, second deployment

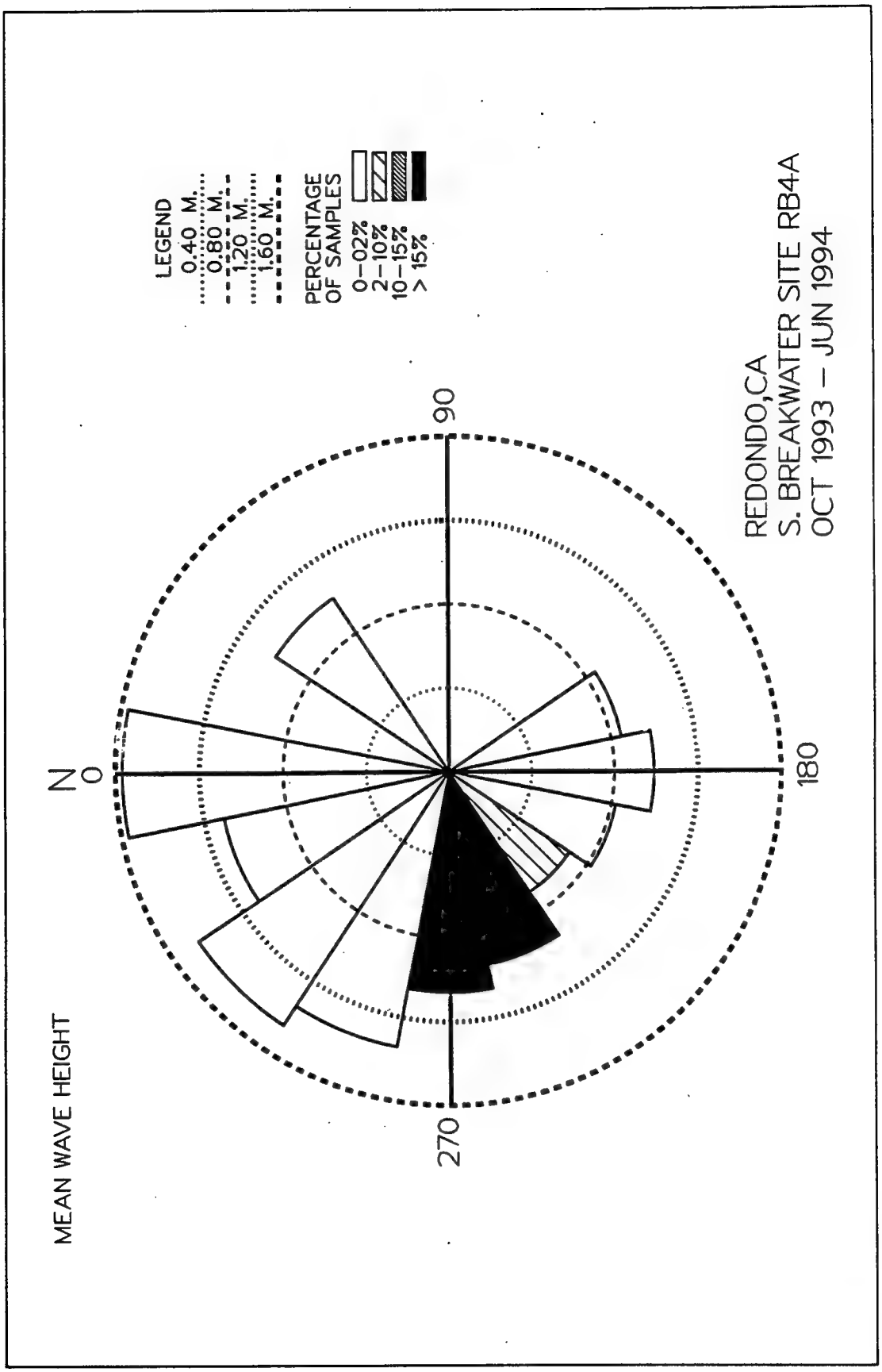

Figure I10. Wave rose for South Breakwater gage (RB4A), second deployment

Table I1
Mean/Max Values for South Breakwater (RB4A)
Second Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR

STATISTICS FOR SOUTH BREAKWATER (33.84 N 118.40 W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1993	.	.	.	.	.	.	.	.	.	0.5	0.7	1.2	0.9
1994	1.0	1.1	1.0	1.1	0.9	1.0	.	.	.	.	.	.	1.0
MEAN	1.0	1.1	1.0	1.1	0.9	1.0	.	.	.	0.5	0.7	1.2	

LARGEST Hm0(METERS) BY MONTH AND YEAR

STATISTICS FOR SOUTH BREAKWATER (33.84 N 118.40 W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1993	.	.	.	.	.	.	.	.	.	0.9	3.0	3.0
1994	2.4	3.0	4.0	3.3	2.1	1.6	.	.	.	.	.	.

STATISTICS FOR SOUTH BREAKWATER (33.84 N 118.40 W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	1.0
THE MEAN PEAK WAVE PERIOD (SECONDS)=	10.2
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	247.5
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	4.0
THE LARGEST Hm0(METERS)=	4.0
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	4.0
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	286.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	94032302

Table I2
Percent Occurrence for South Breakwater (RB4A)
Second Deployment

SOUTH BREAKWATER 33.84 N 118.40 W FOR ALL DIRECTIONS
OCTOBER 1993 - JUNE 1994
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	SHORTER-4.5	4.6-5.6	5.6-8.0	8.0-10.6	10.7-11.6	11.6-12.7	12.8-14.1	14.2-15.9	16.0-18.3	18.4-LONGER	
0.0-0.4	1170	36	36	1133	1261	1225	2798	2322	402	420	10803
0.5-0.9	9253	841	4005	4005	2231	3017	11667	12179	1389	804	49391
1.0-1.4	7187	274	3712	3035	987	1499	7809	5230	201	91	30025
1.5-1.9	1682	73	1188	749	292	91	932	914	18	18	5957
2.0-2.4	1207	.	310	146	54	128	457	219	.	.	2521
2.5-2.9	420	18	91	128	109	146	109	73	.	.	1094
3.0-3.4	91	.	36	18	.	.	.	.	.	.	145
3.5-3.9	.	.	.	18	.	.	.	.	.	.	18
4.0-4.4	18	.	.	.	.	.	.	.	.	.	18
4.5-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	21028	1242	9378	9232	4934	6106	23772	20937	2010	1333	

MEAN Hm0(M)= 1.0 LARGEST Hm0(M)= 4.0 MEAN TP(SEC)= 10.2 TOTAL CASES= 5468.

Appendix J
Redondo Site, Second Deployment

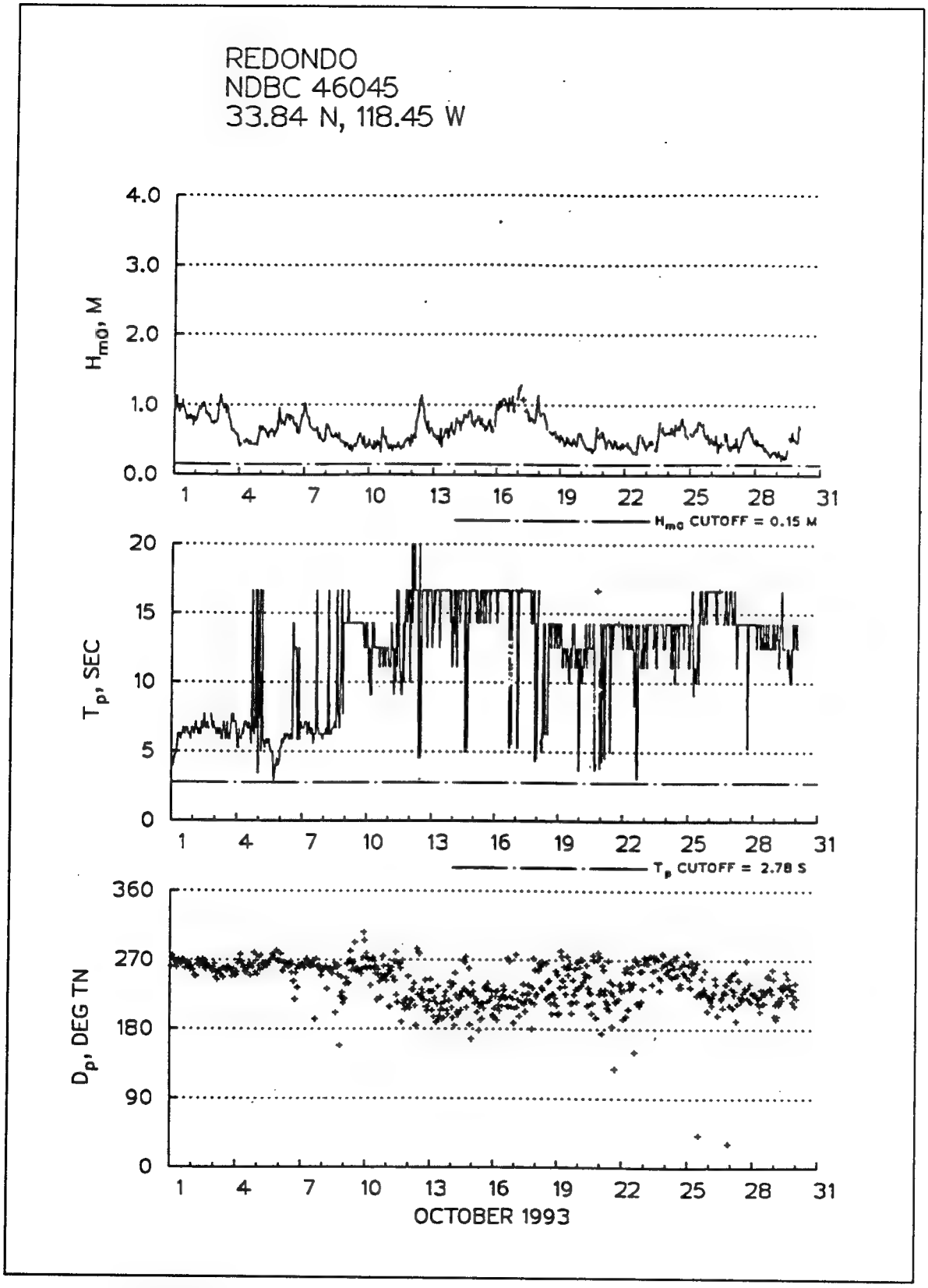

Figure J1. Time series plot for Redondo gage (NDBC 46045), October 1993, second deployment

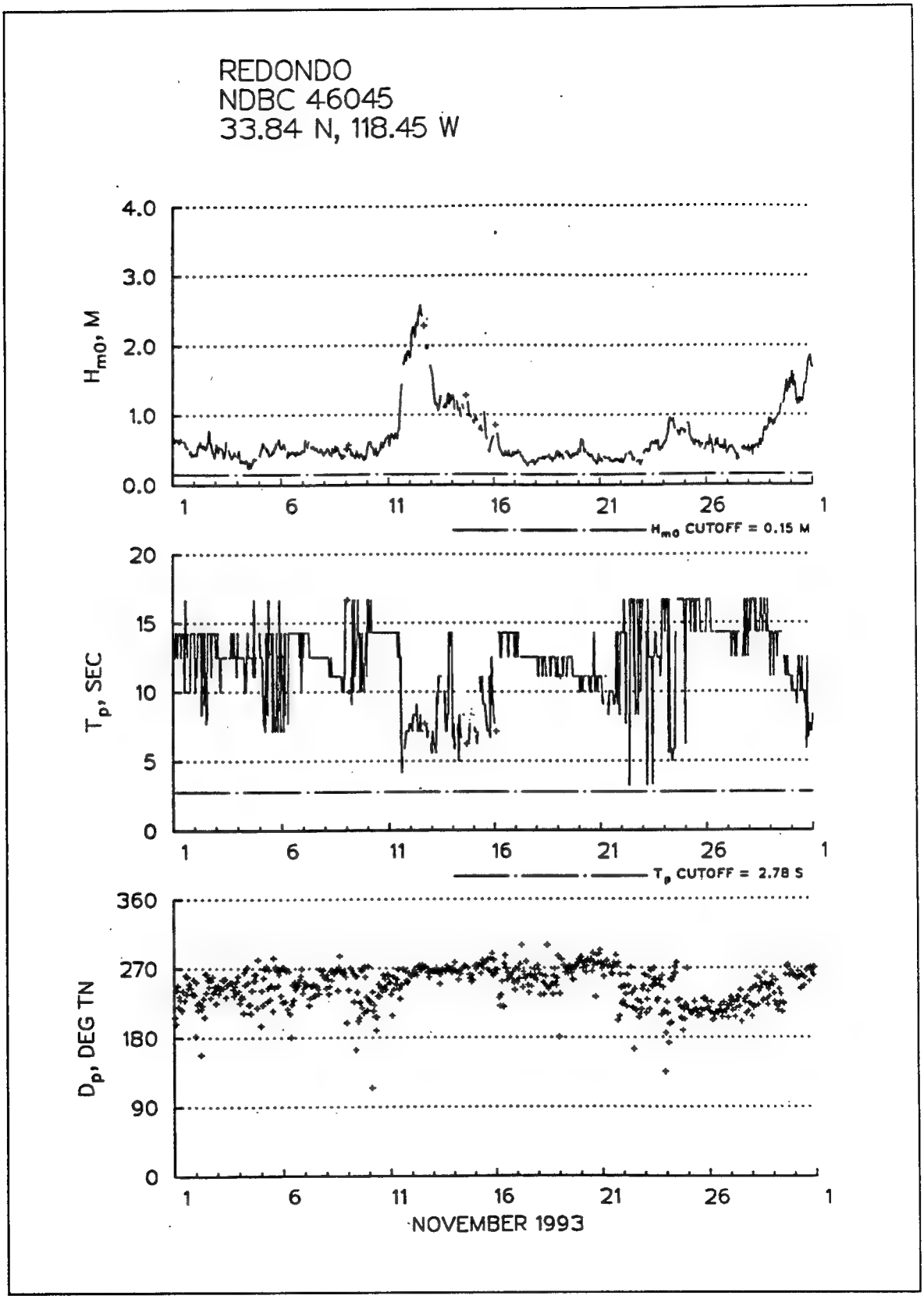

Figure J2. Time series plot for Redondo gage (NDBC 46045), November 1993, second deployment

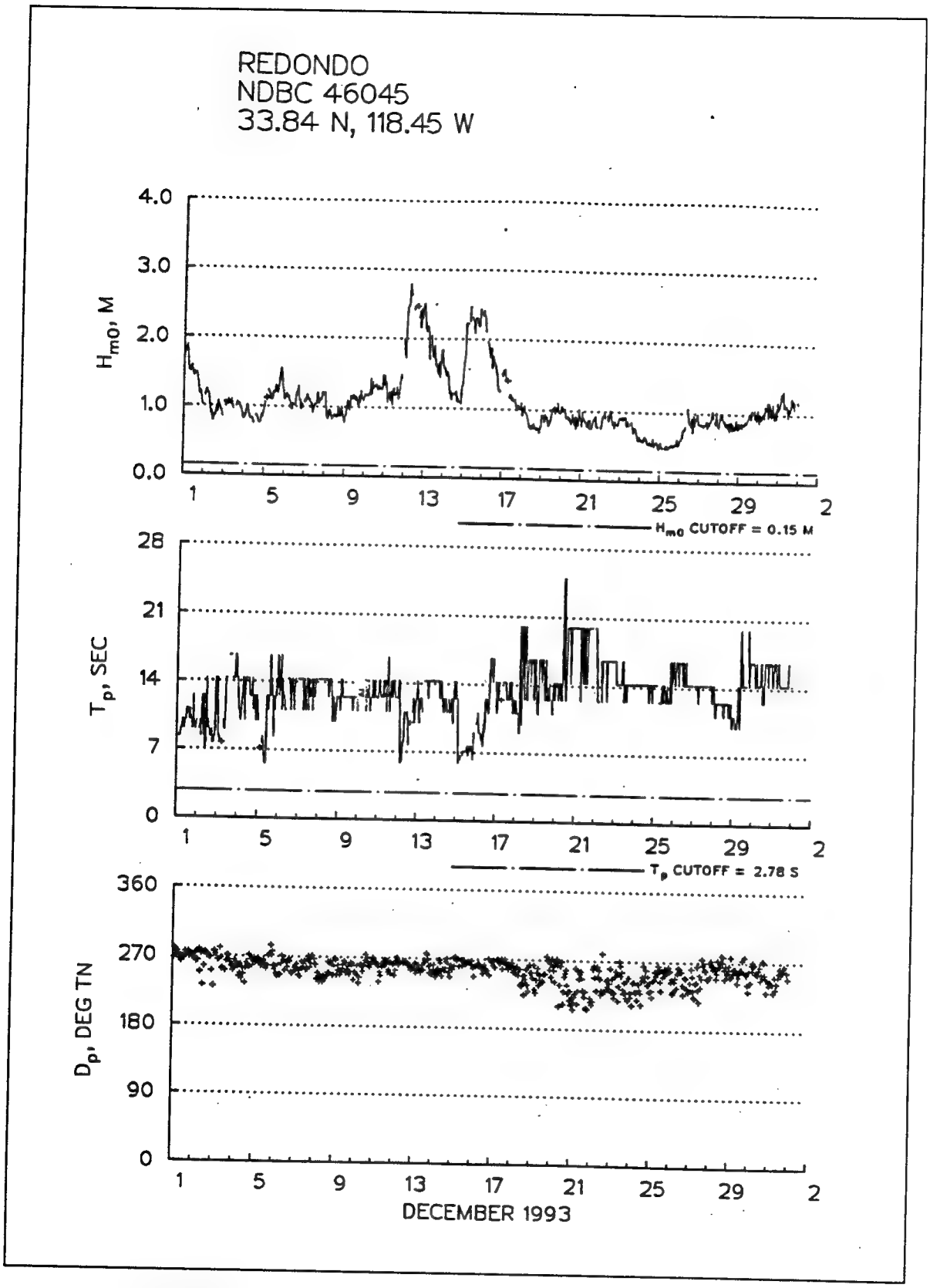

Figure J3. Time series plot for Redondo gage (NDBC 46045), December 1993, second deployment

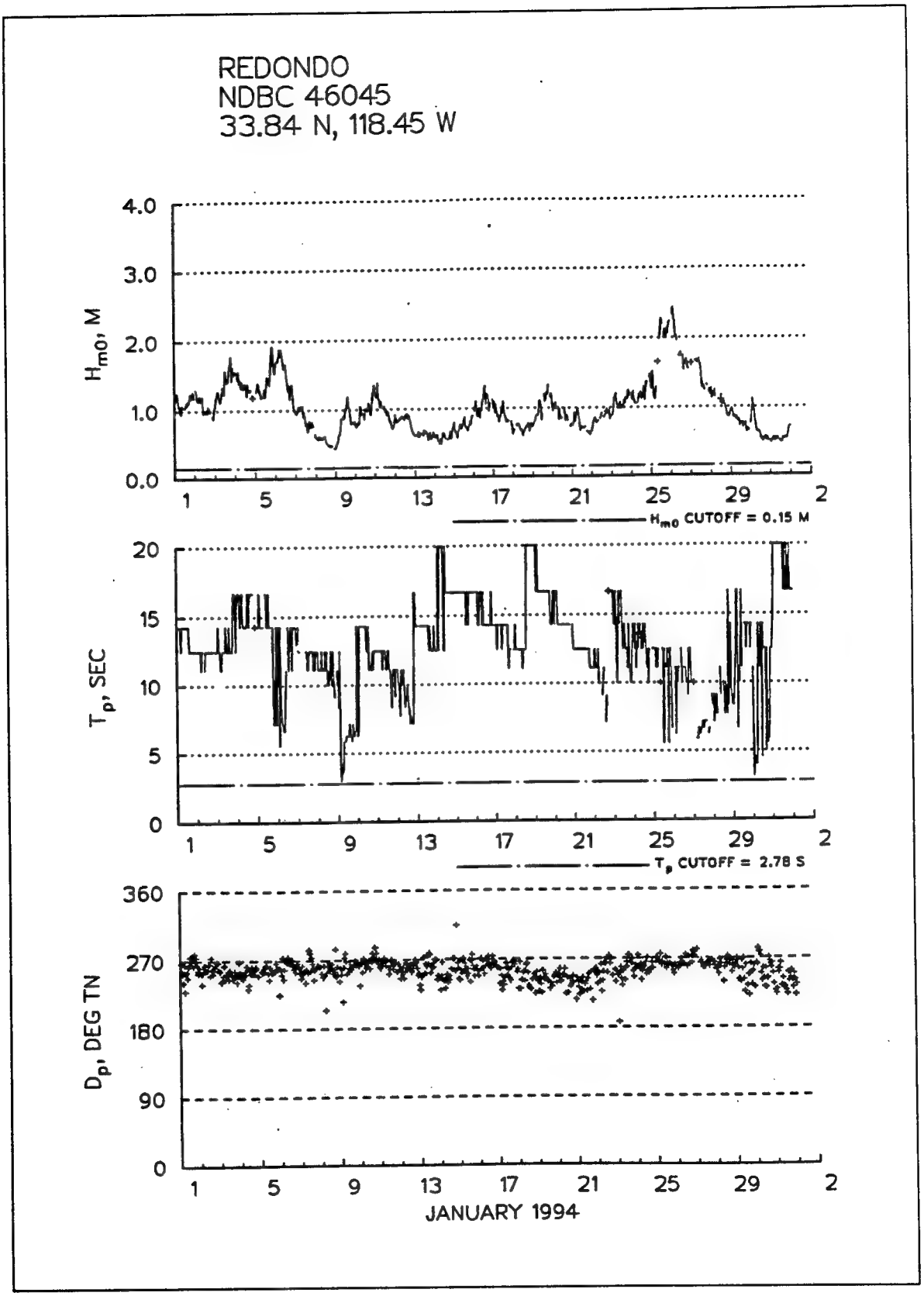

Figure J4. Time series plot for Redondo gage (NDBC 46045), January 1994, second deployment

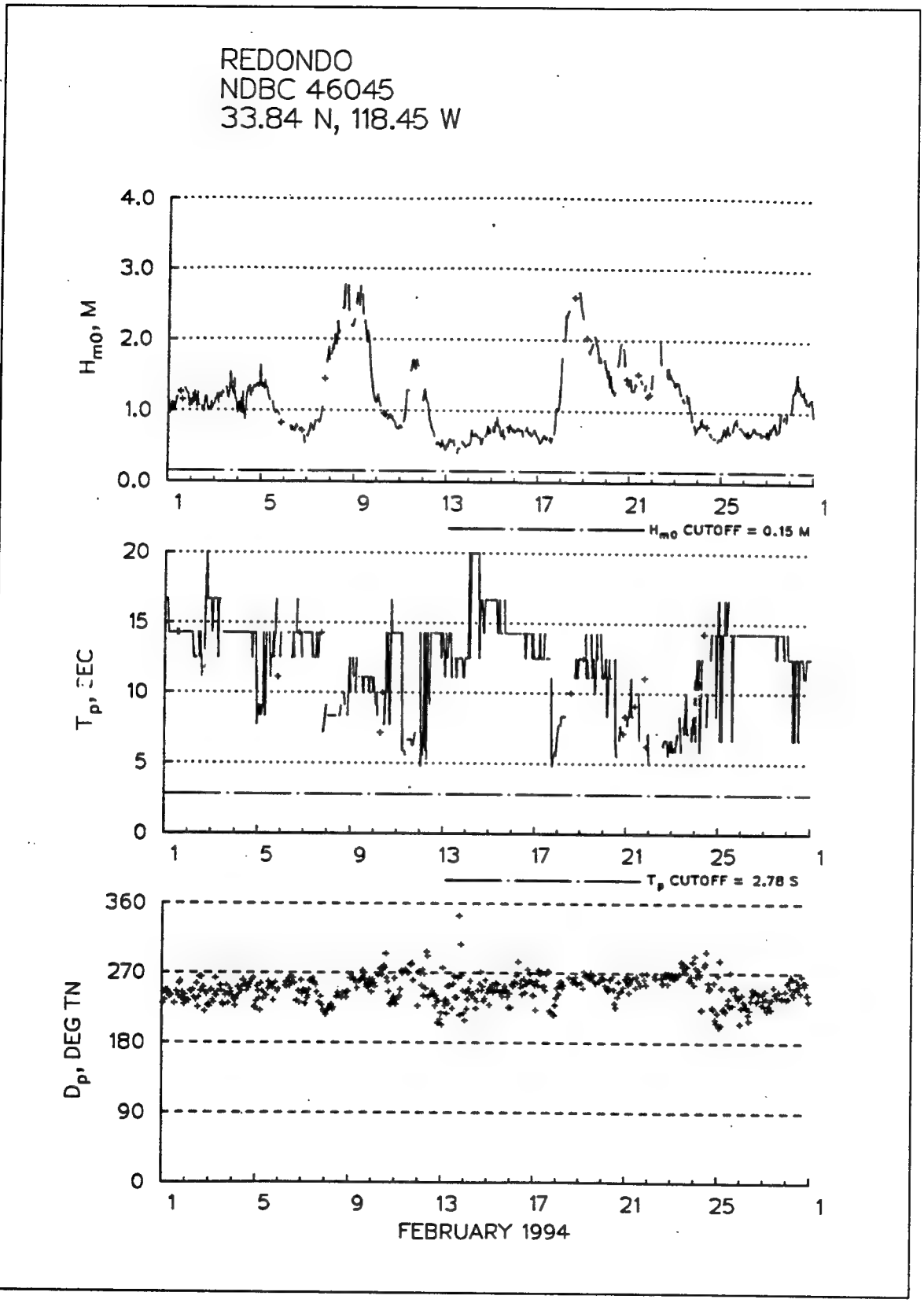

Figure J5. Time series plot for Redondo gage (NDBC 46045), February 1994, second deployment

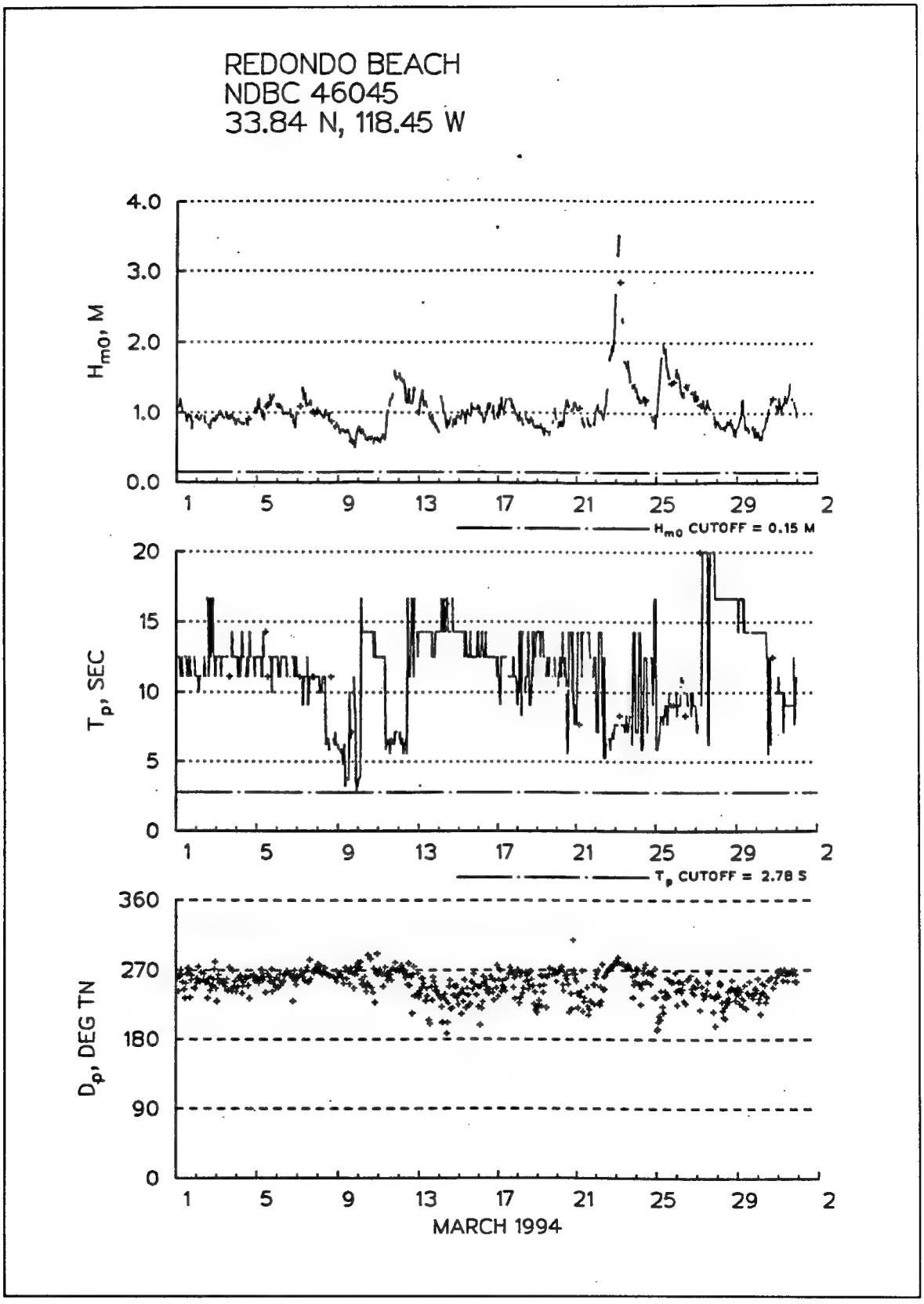

Figure J6. Time series plot for Redondo gage (NDBC 46045), March 1994, second deployment

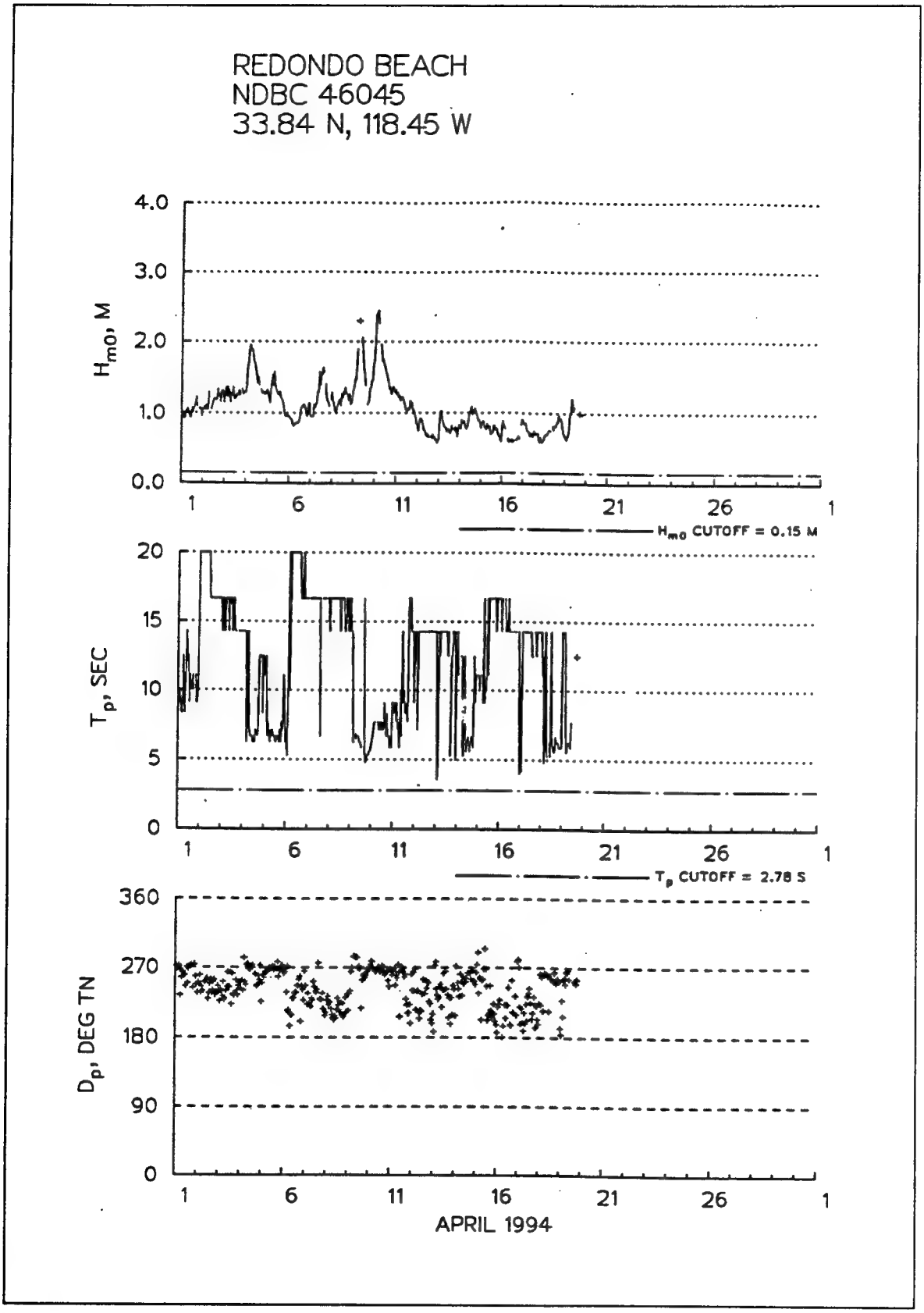

Figure J7. Time series plot for Redondo gage (NDBC 46045), April 1994, second deployment

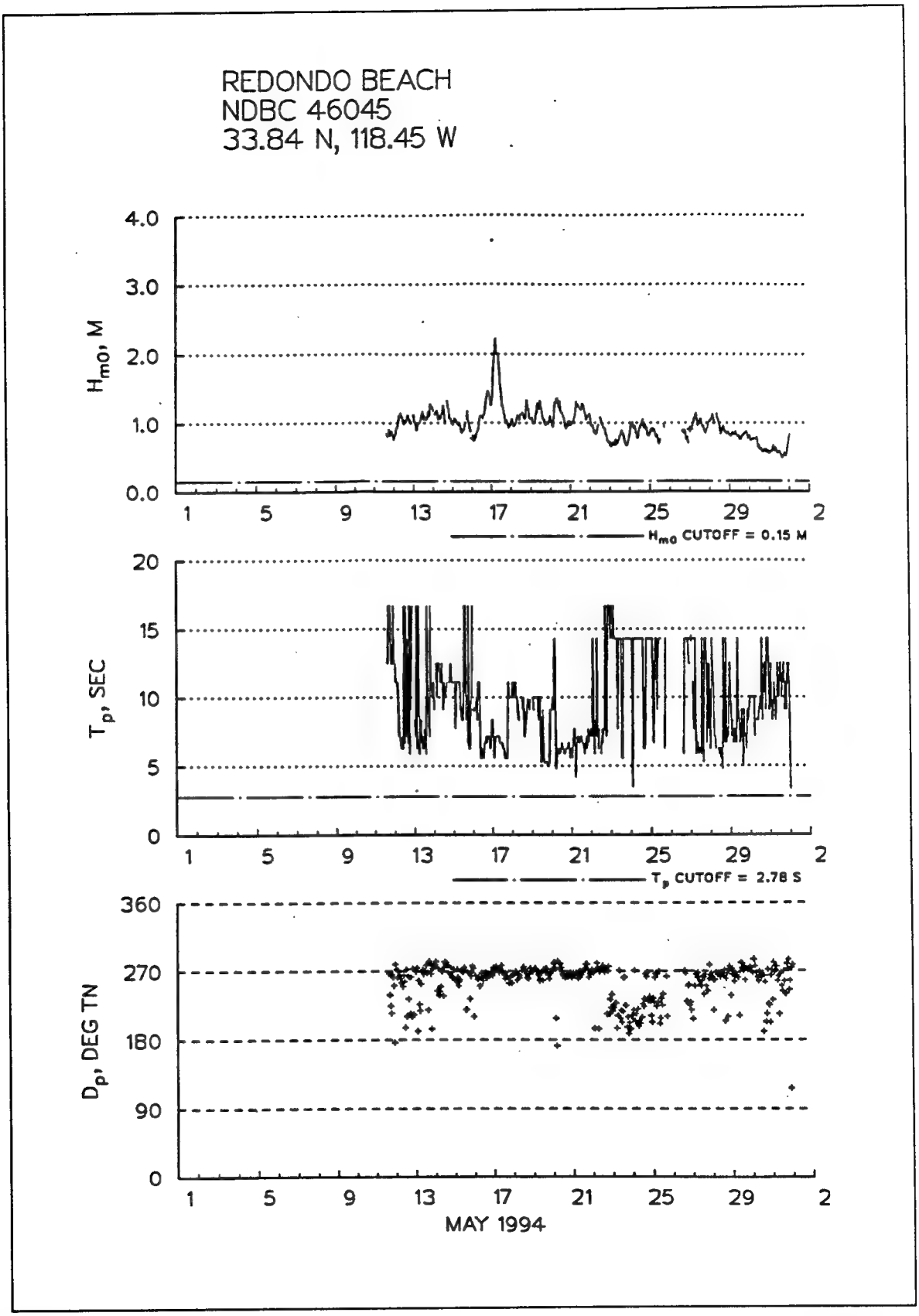

Figure J8. Time series plot for Redondo gage (NDBC 46045), May 1994, second deployment

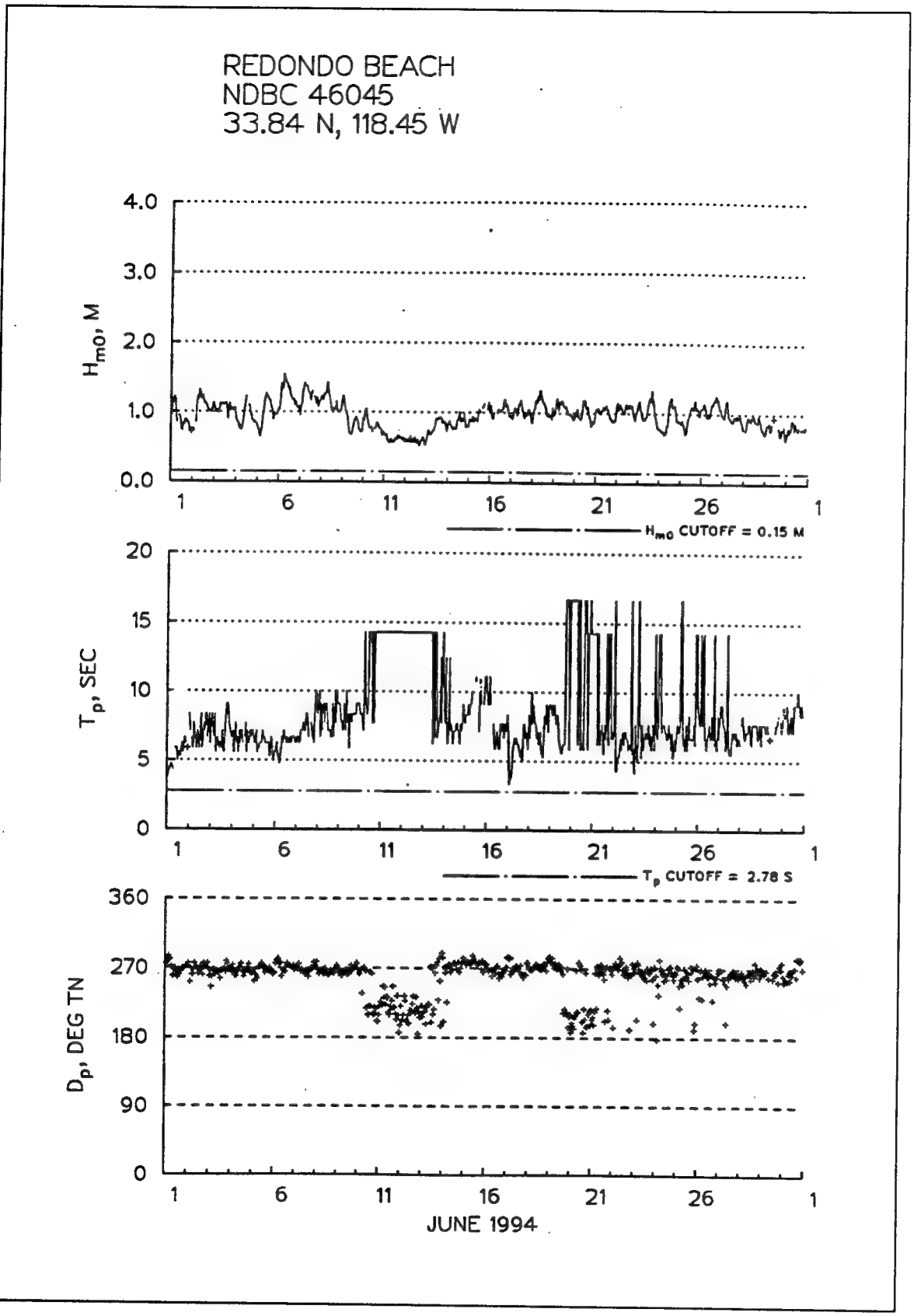

Figure J9. Time series plot for Redondo gage (NDBC 46045), June 1994, second deployment

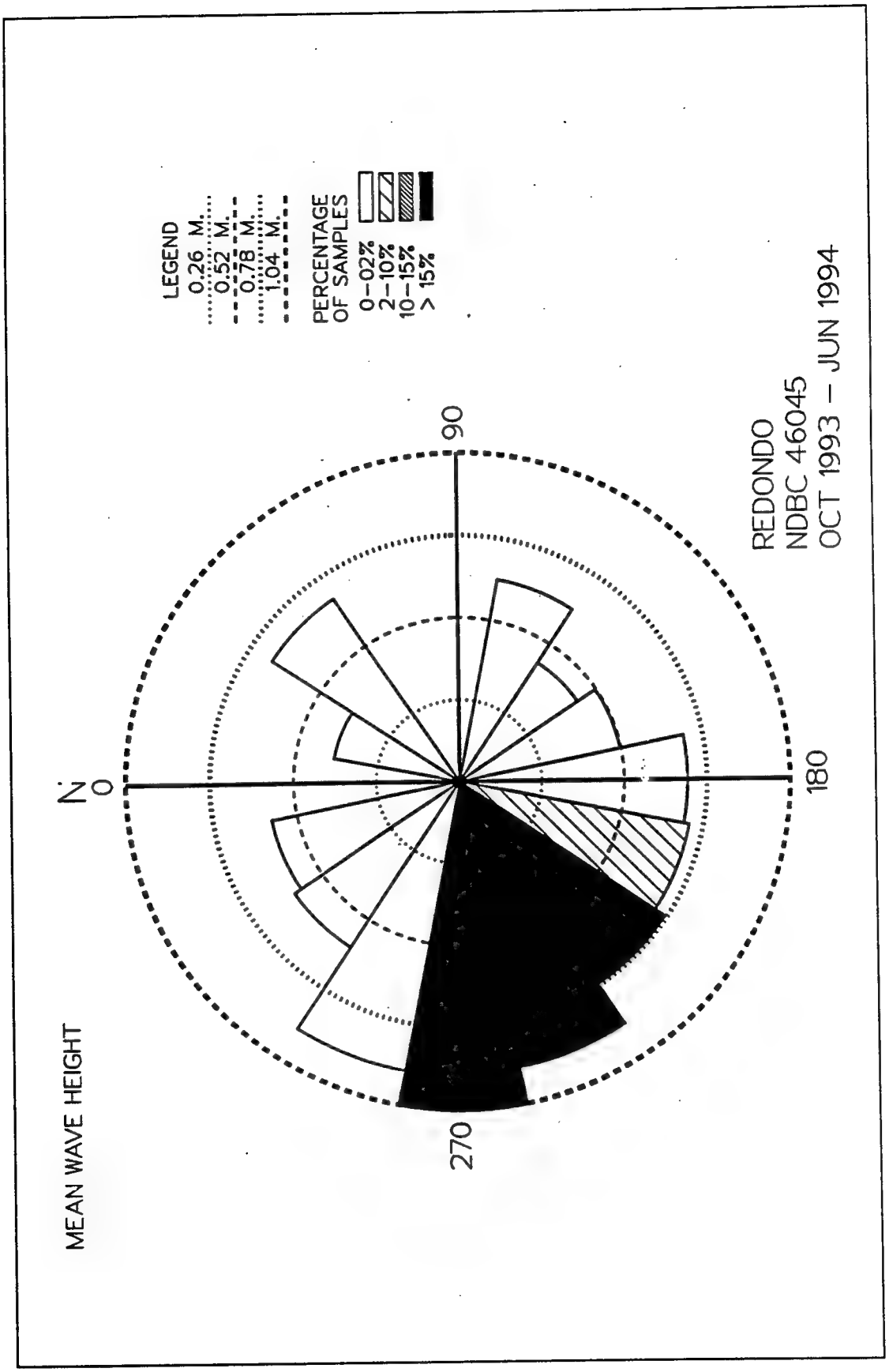

Figure J10. Wave rose for Redondo gage (NDBC 46045), second deployment

Table J1
Mean/Max Values for Redondo (NDBC 46045)
Second Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46045 (33.84N 118.45W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1993	.	.	.	.	.	.	.	.	.	0.6	0.7	1.1	0.8
1994	1.0	1.1	1.0	1.1	1.0	1.0	.	.	.	.	.	.	1.0
MEAN	1.0	1.1	1.0	1.1	1.0	1.0	.	.	.	0.6	0.7	1.1	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46045 (33.84N 118.45W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1993	.	.	.	.	.	.	.	.	.	1.3	2.6	2.8
1994	2.4	2.8	3.5	2.5	2.2	1.5	.	.	.	.	.	.

STATISTICS FOR NDBC BUOY 46045 (33.84N 118.45W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	0.9
THE MEAN PEAK WAVE PERIOD (SECONDS)=	11.6
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	270.0
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	3.7
THE LARGEST Hm0(METERS)=	3.5
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	7.7
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	287.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	94032302

Table J2
Percent Occurrence for Redondo (NDBC 46045)
Second Deployment

BUOY STATION 46045 33.84 N 118.45 W FOR ALL DIRECTIONS
OCTOBER 1993 - JUNE 1994
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	<6.9	6.9-8.0	8.1-8.7	8.8-9.5	9.6-10.5	10.6-11.7	11.8-13.3	13.4-15.3	15.4-18.1	18.2-LONGER	
0.0-0.9	632	314	136	143	224	435	974	1861	728	158	5605
1.0-1.9	902	440	179	212	206	348	620	742	399	55	4103
2.0-2.9	41	66	39	10	23	50	35	7	.	.	271
3.0-3.9	.	5	.	.	.	.	.	.	.	.	5
4.0-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0-5.9	.	.	.	.	.	.	.	.	.	.	0
6.0-6.9	.	.	.	.	.	.	.	.	.	.	0
7.0-7.9	.	.	.	.	.	.	.	.	.	.	0
8.0-8.9	.	.	.	.	.	.	.	.	.	.	0
9.0-9.9	.	.	.	.	.	.	.	.	.	.	0
10.0+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	1575	825	354	365	453	833	1629	2610	1127	213	

MEAN Hm0(M)= 0.9 LARGEST Hm0(M)= 3.5 MEAN TP(SEC)= 11.6 TOTAL CASES= 5561.

Appendix K
Catalina Ridge Site, Second Deployment

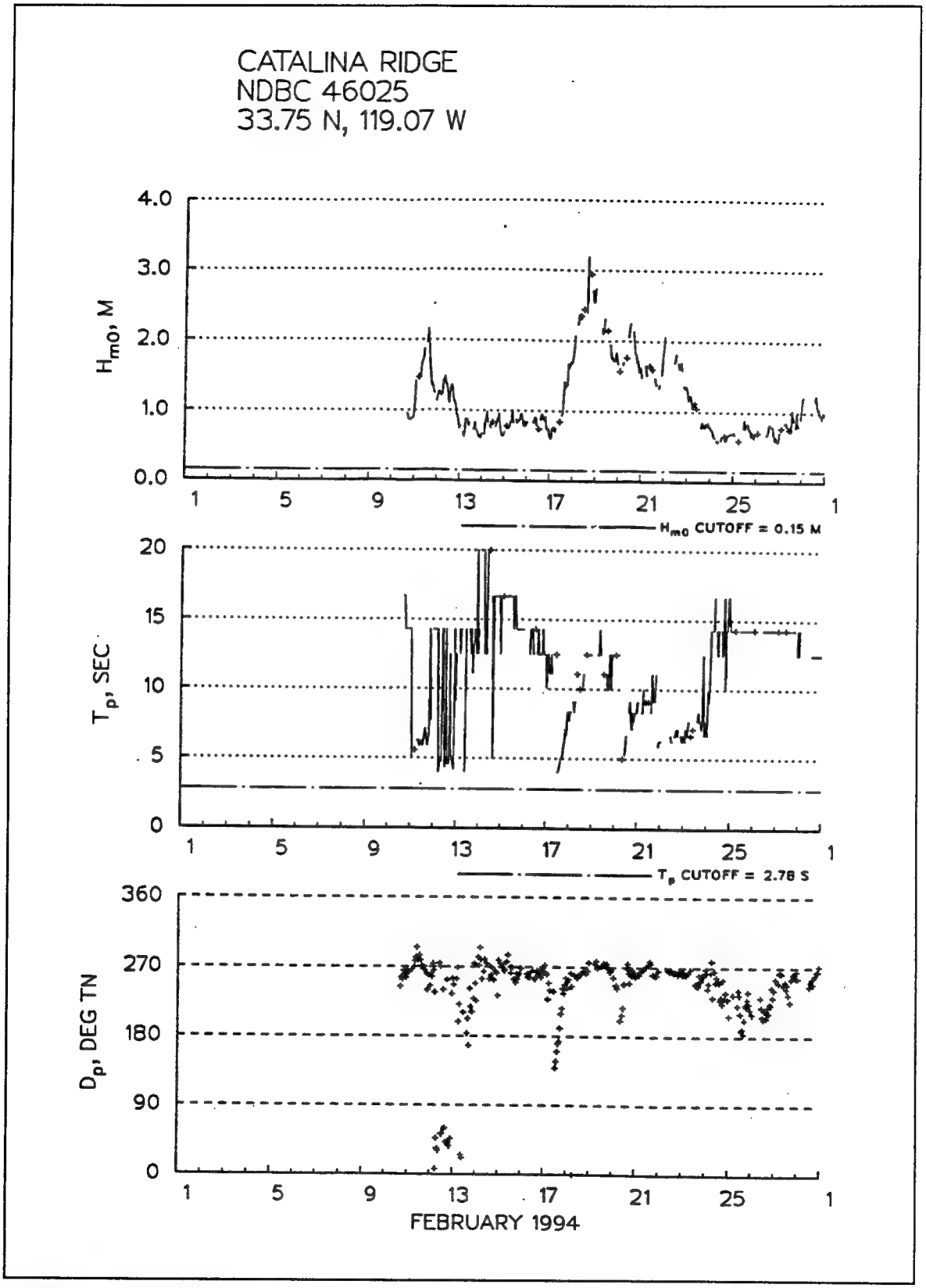

Figure K1. Time series plot for Catalina Ridge gage (NDBC 46025), February 1994, second deployment

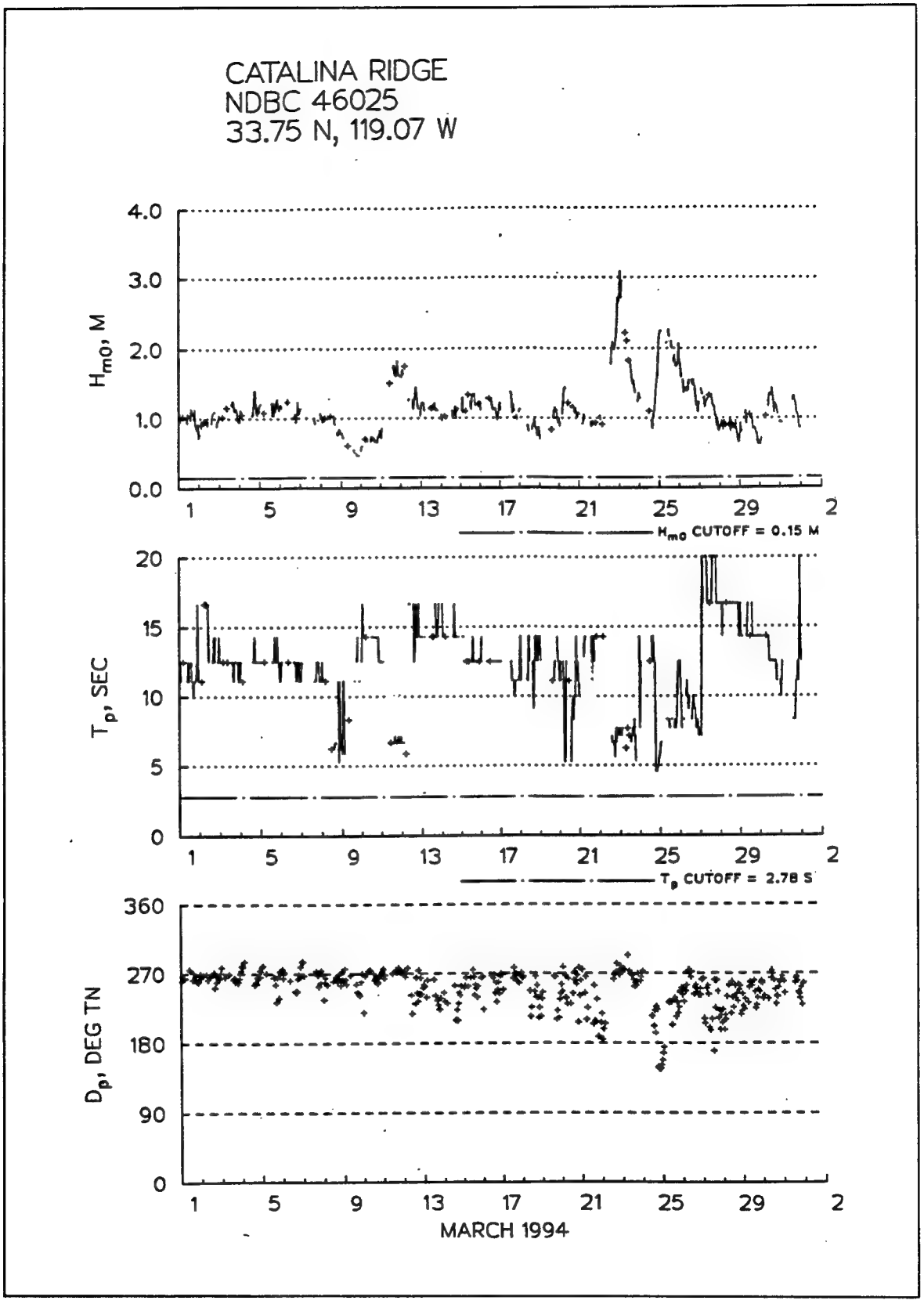

Figure K2. Time series plot for Catalina Ridge gage (NDBC 46025), March 1994, second deployment

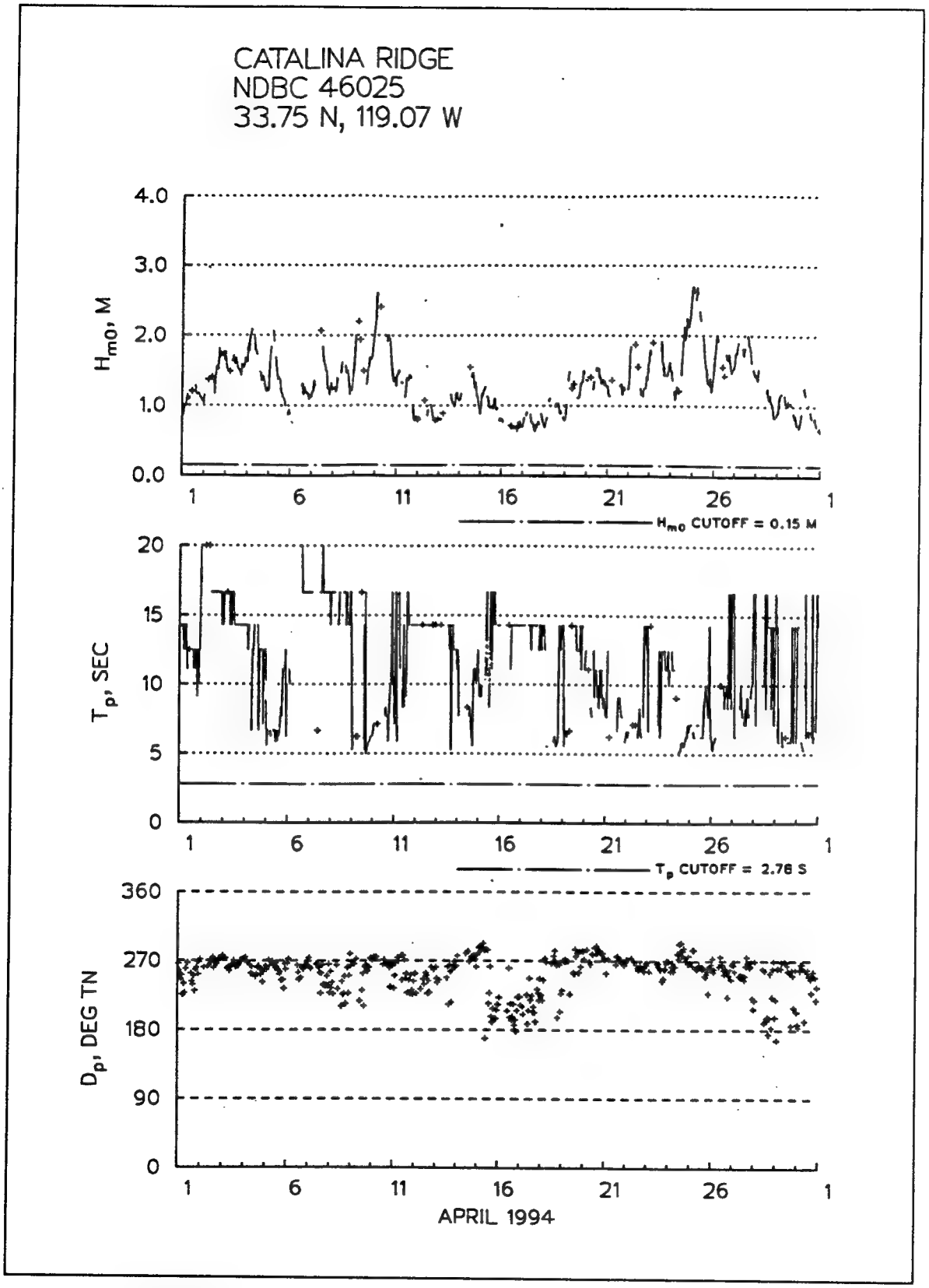

Figure K3. Time series plot for Catalina Ridge gage (NDBC 46025), April 1994, second deployment

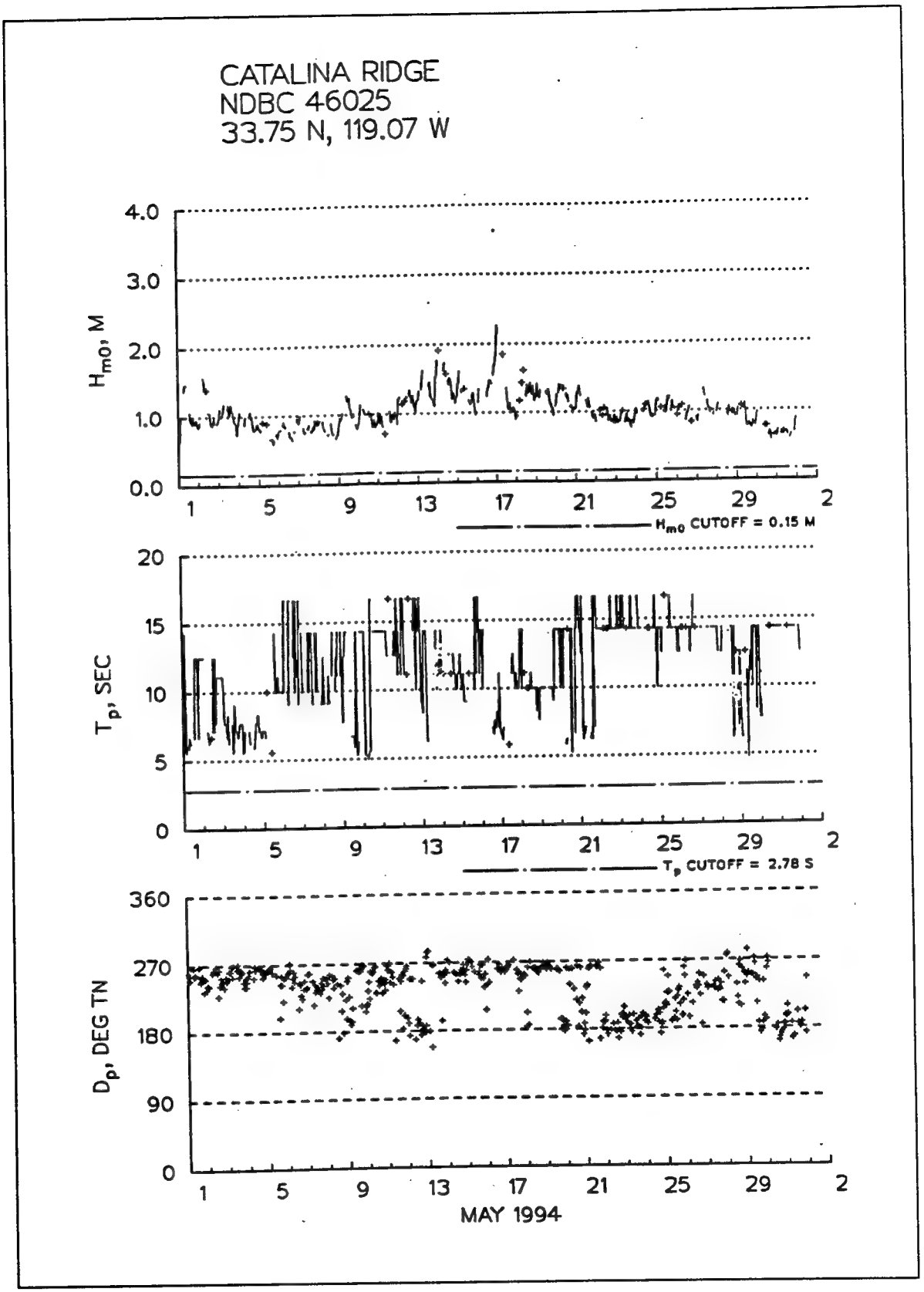

Figure K4. Time series plot for Catalina Ridge gage (NDBC 46025), May 1994, second deployment

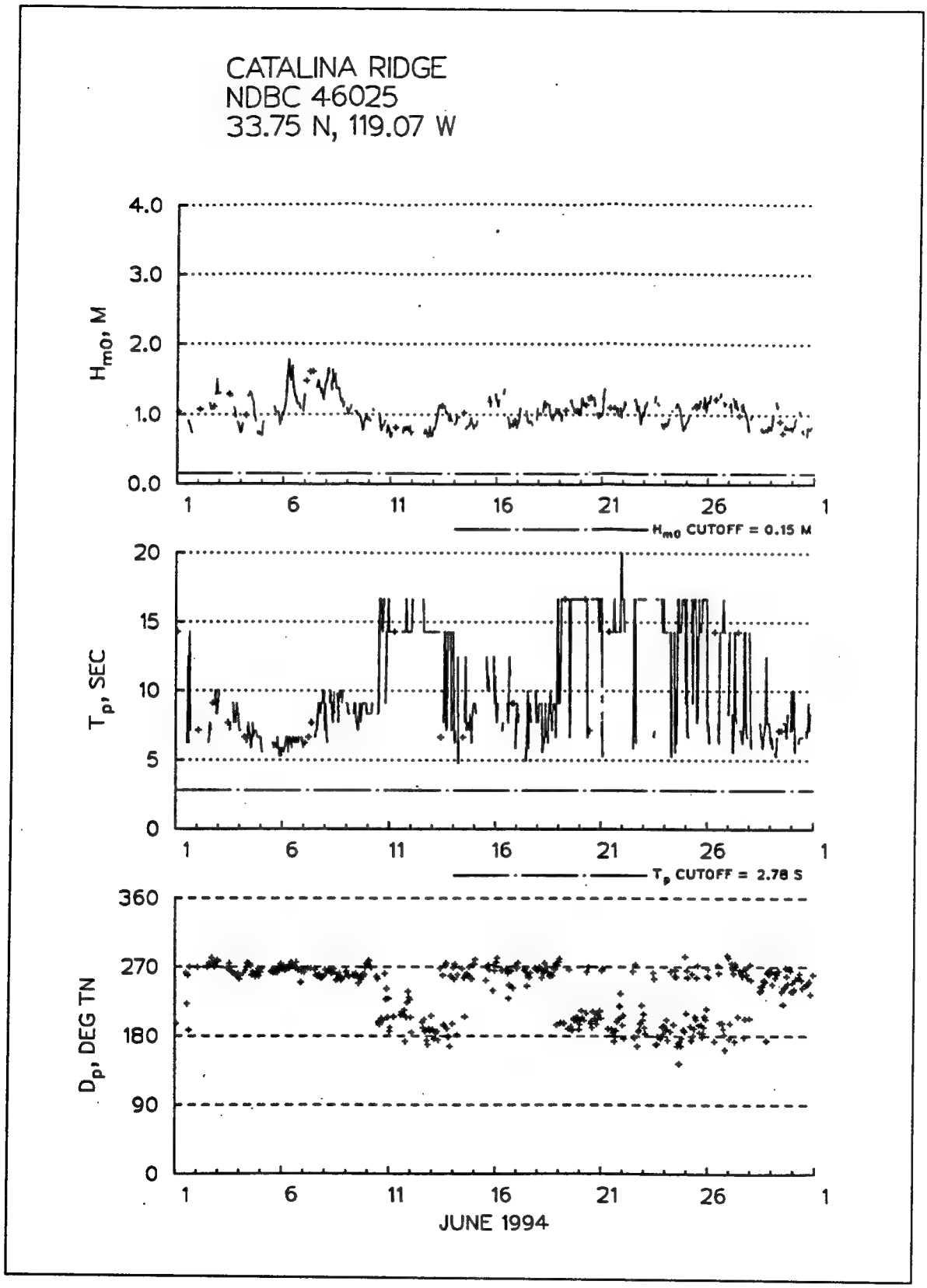

Figure K5. Time series plot for Catalina Ridge gage (NDBC 46025), June 1994, second deployment

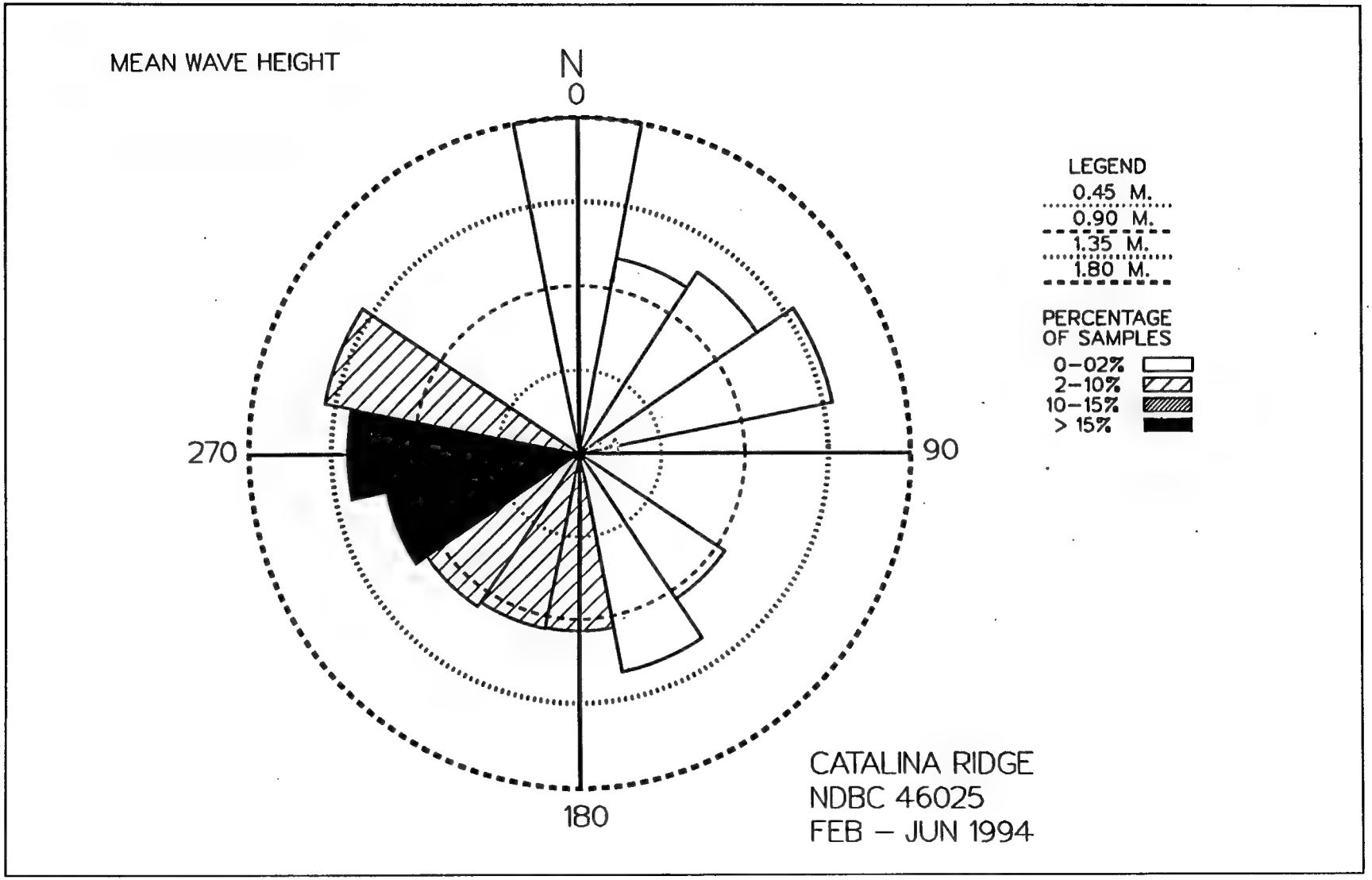

Figure K6. Wave rose for Catalina Ridge gage (NDBC 46025), second deployment

Table K1
Mean/Max Values for Catalina Ridge (NDBC 46025)
Second Deployment

MEAN Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46025 (33.75N 119.07W)

	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
YEAR													MEAN
1994	.	1.2	1.2	1.3	1.0	1.0	.	.	.	.	.	.	1.1
MEAN	.	1.2	1.2	1.3	1.0	1.0	.	.	.	.	.	.	

LARGEST Hm0(METERS) BY MONTH AND YEAR
NDBC BUOY 46025 (33.75N 119.07W)

	MONTH											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
YEAR												
1994	.	3.2	3.1	2.7	2.3	1.8	.	.	.	.	.	.

STATISTICS FOR NDBC BUOY 46025 (33.75N 119.07W)

THE MEAN SIGNIFICANT WAVE HEIGHT(METERS)=	1.1
THE MEAN PEAK WAVE PERIOD (SECONDS)=	11.4
THE MOST FREQUENT 22.5(CENTER) DIRECTION BAND (DEGREES)=	270.0
THE STANDARD DEVIATION OF Hm0(METERS)=	0.4
THE STANDARD DEVIATION OF TP(SECONDS)=	3.7
THE LARGEST Hm0(METERS)=	3.2
THE TP(SECONDS)ASSOC. WITH THE LARGEST Hm0=	11.1
THE PEAK DIRECTION (DEGREES) ASSOC. WITH THE LARGEST Hm0=	261.0
THE DATE OF LARGEST Hm0 OCCURRENCE IS	94021815

Table K2
Percent Occurrence for Catalina Ridge (NDBC 46025)
Second Deployment

BUOY STATION 46025 33.75 N 119.07 W FOR ALL DIRECTIONS
FEBRUARY 1994 - JUNE 1994
PERCENT OCCURRENCE(X100) OF HEIGHT AND PERIOD

HEIGHT(METERS)	PEAK PERIOD(SECONDS)										TOTAL
	<6.9	6.9-8.0	8.1-8.7	8.8-9.5	9.6-10.5	10.6-11.7	11.8-13.3	13.4-15.3	15.4-18.1	18.2-LONGER	
0.0-0.9	297	293	74	144	166	209	389	1517	363	30	3482
1.0-1.9	1211	529	314	323	415	472	791	1106	839	87	6087
2.0-2.9	174	96	43	13	8	13	39	13	.	.	399
3.0-3.9	.	8	.	.	.	4	4	.	.	.	16
4.0-4.9	.	.	.	.	.	.	.	.	.	.	0
5.0-5.9	.	.	.	.	.	.	.	.	.	.	0
6.0-6.9	.	.	.	.	.	.	.	.	.	.	0
7.0-7.9	.	.	.	.	.	.	.	.	.	.	0
8.0-8.9	.	.	.	.	.	.	.	.	.	.	0
9.0-9.9	.	.	.	.	.	.	.	.	.	.	0
10.0+	.	.	.	.	.	.	.	.	.	.	
TOTAL	1682	926	431	480	589	698	1223	2636	1202	117	

MEAN Hm0(M)= 1.1 LARGEST Hm0(M)= 3.2 MEAN TP(SEC)= 11.4 TOTAL CASES= 2286.

Appendix L
Additional NDBC Time Series Plots

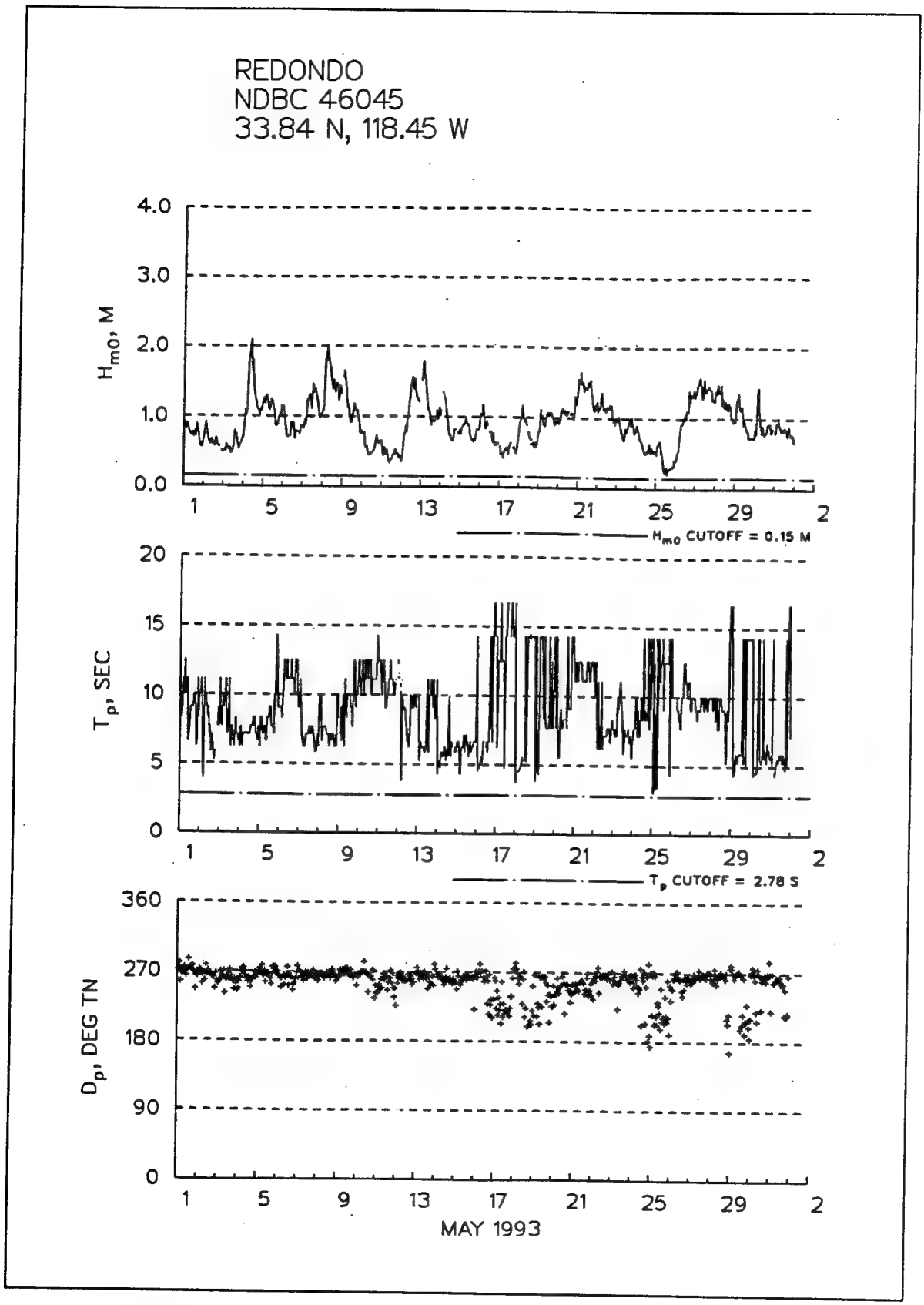

Figure L1. Redondo (NDBC 46045), May 1993

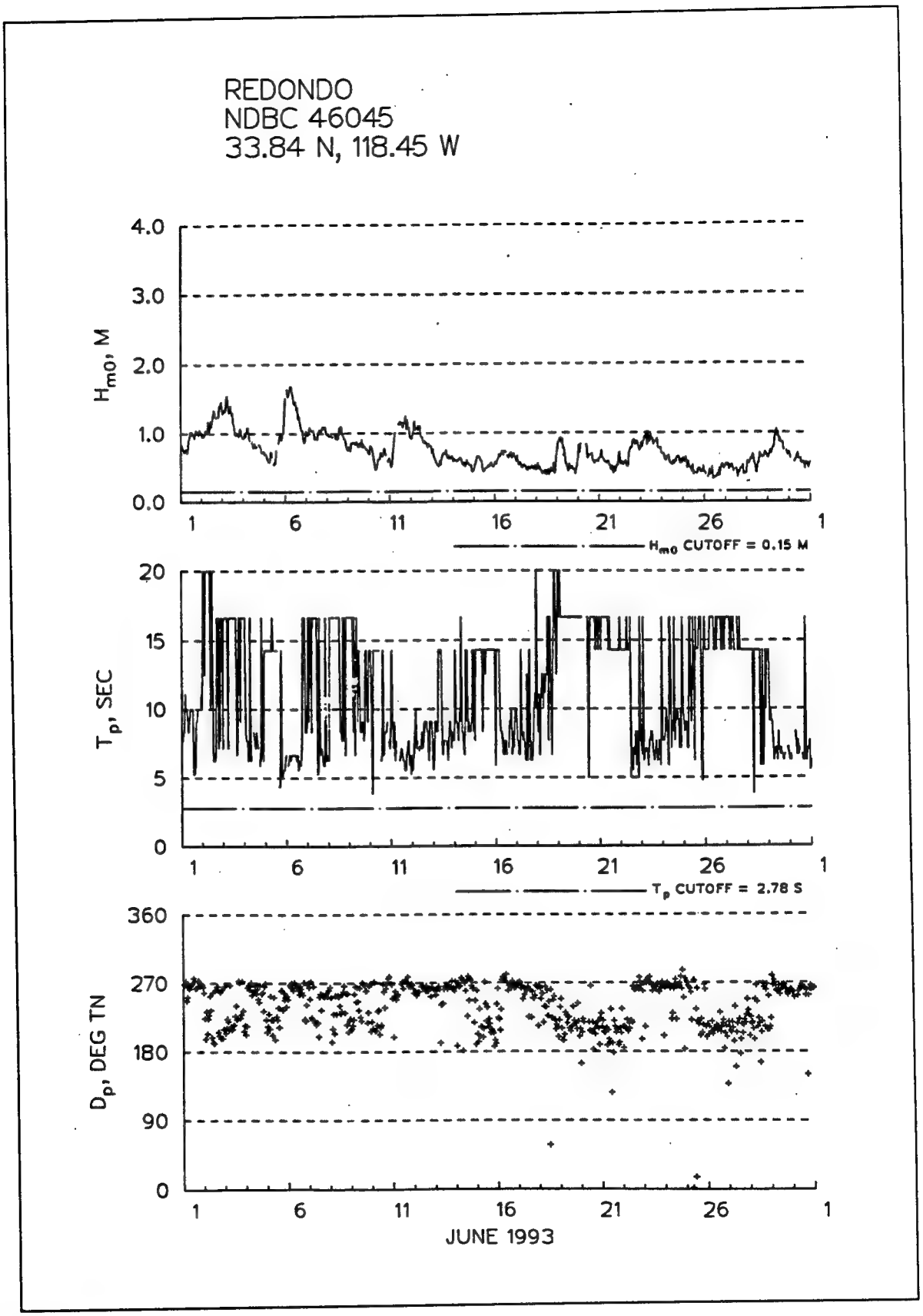

Figure L2. Redondo (NDBC 46045), June 1993

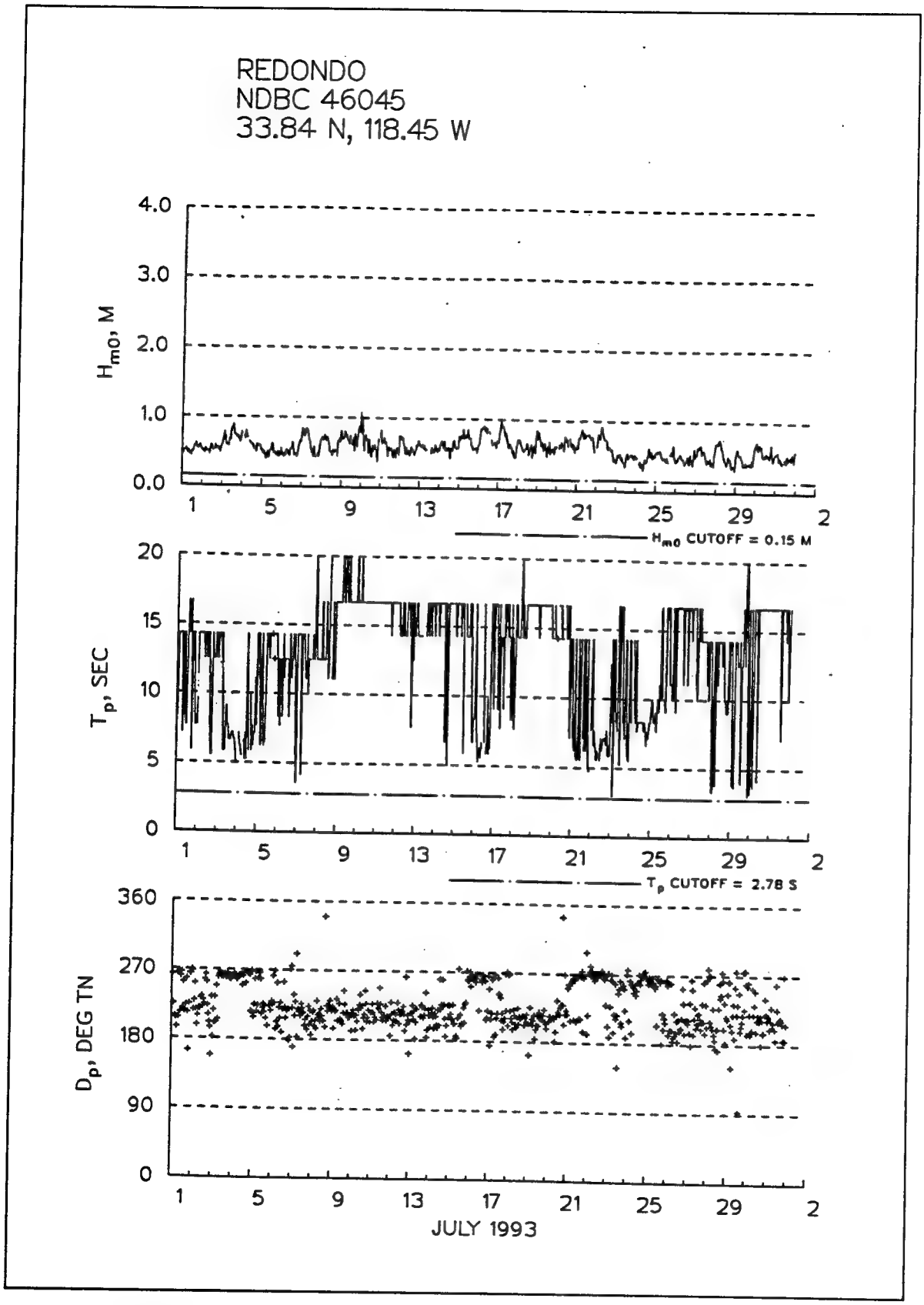

Figure L3. Redondo (NDBC 46045), July 1993

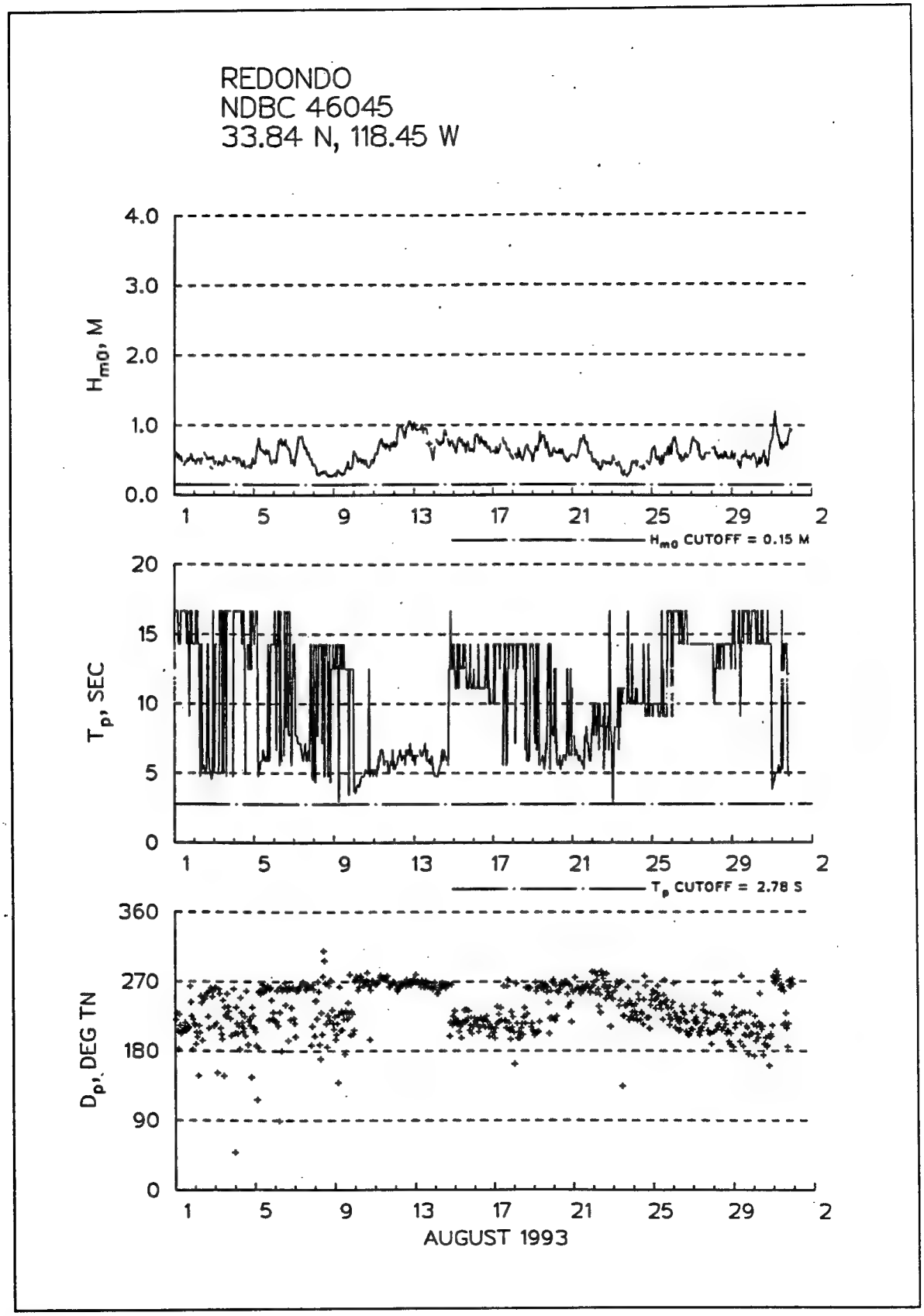

Figure L4. Redondo (NDBC 46045), August 1993

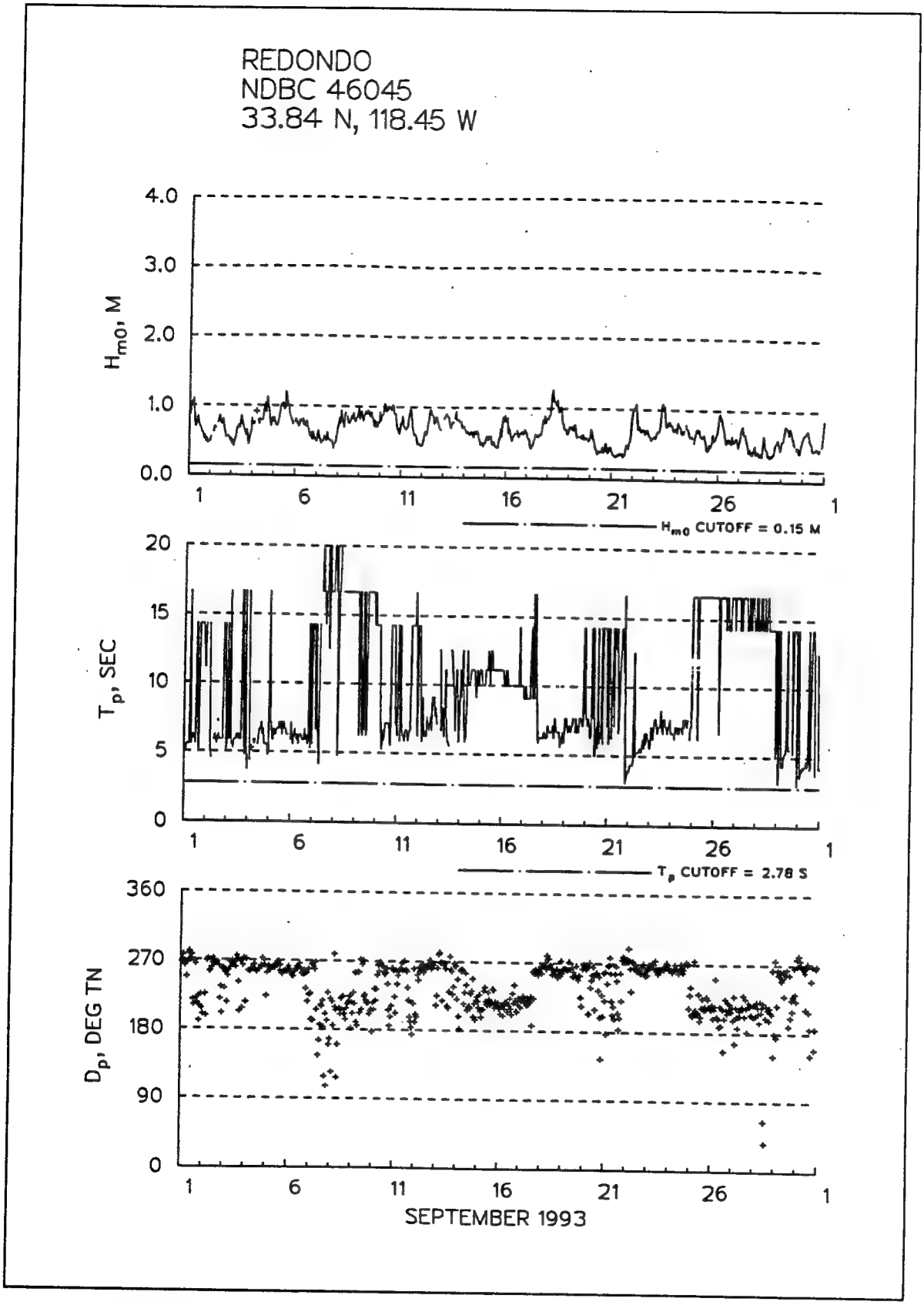

Figure L5. Redondo (NDBC 46045), September 1993

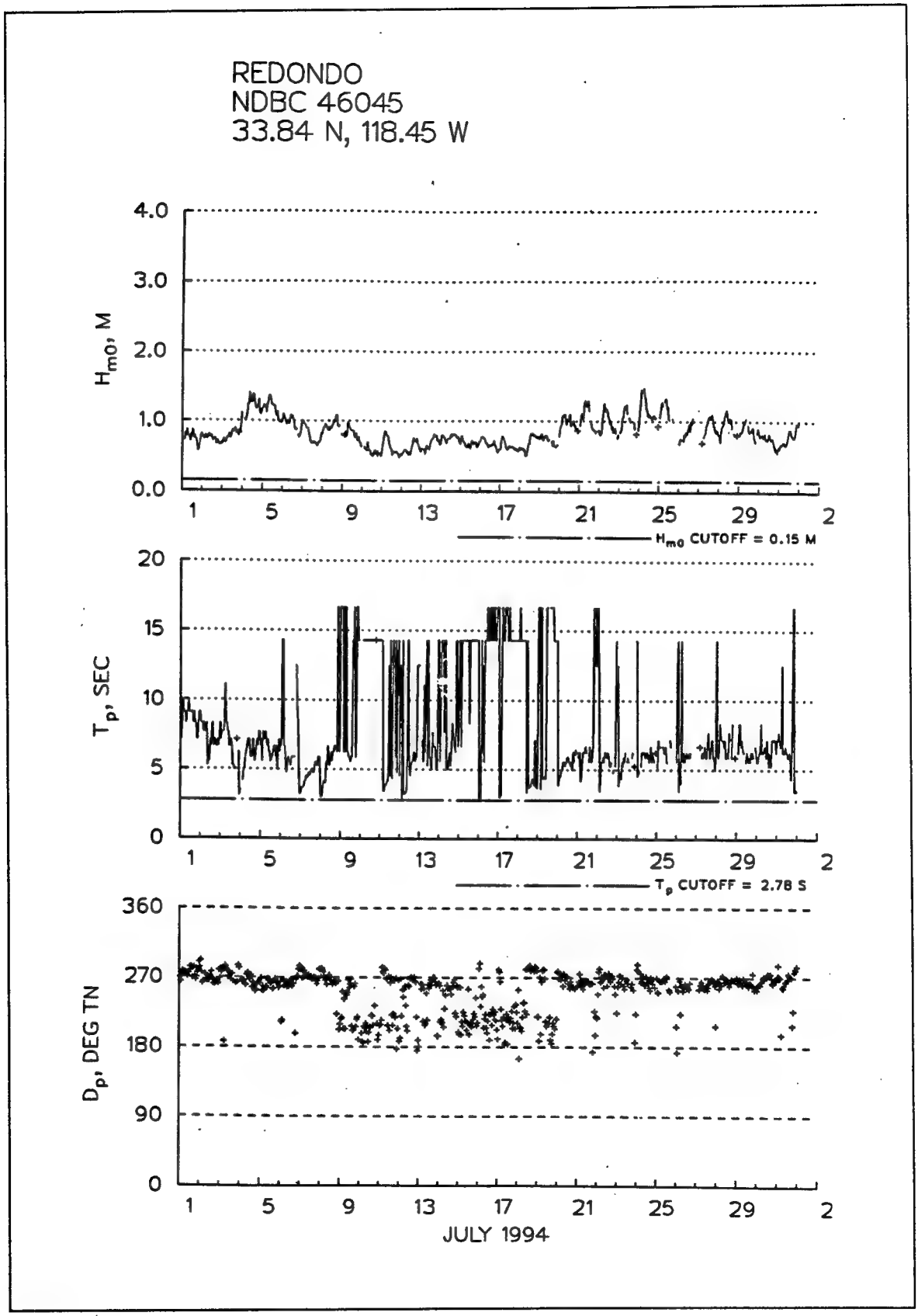

Figure L6. Redondo (NDBC 46045), July 1994

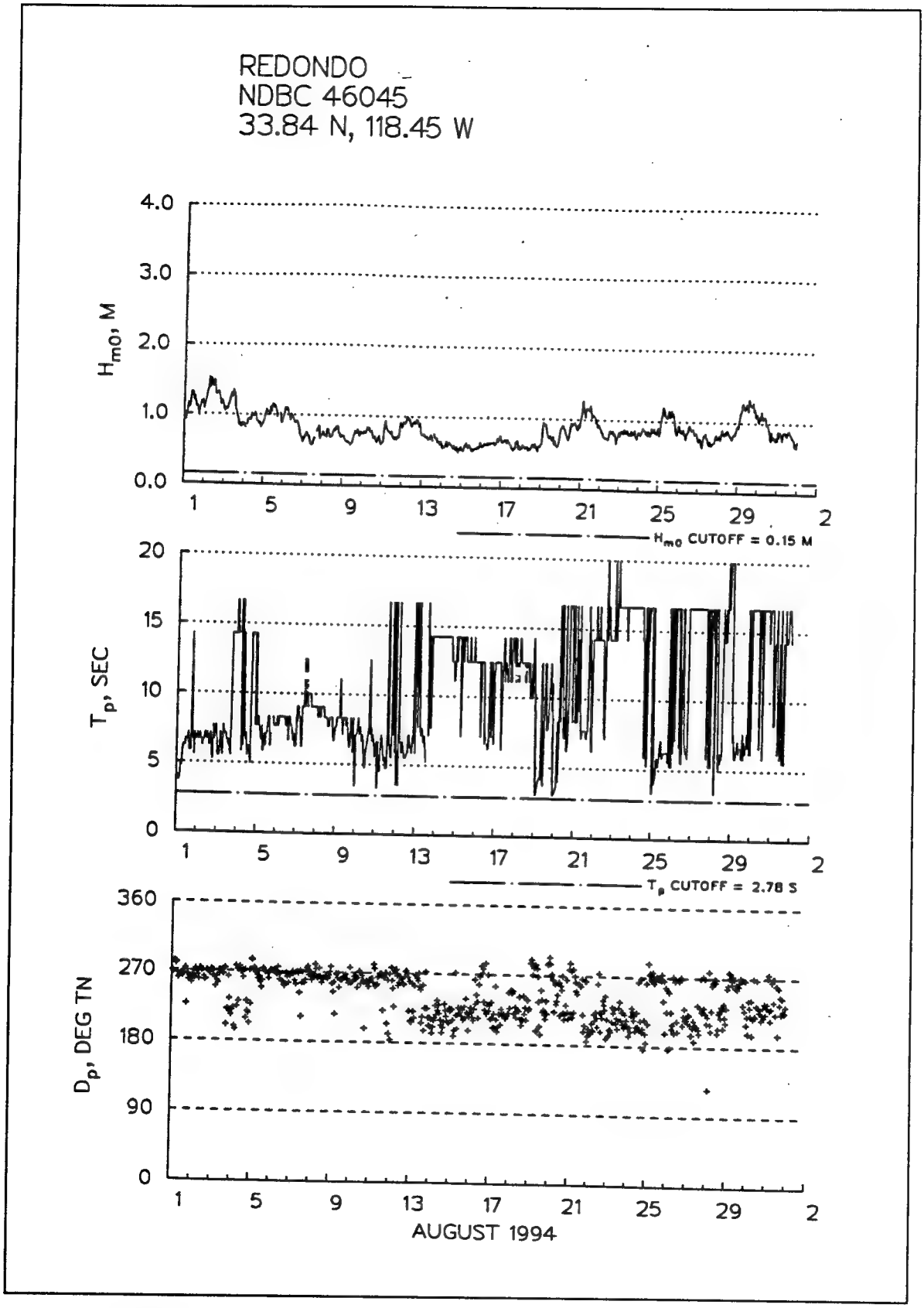

Figure L7. Redondo (NDBC 46045), August 1994

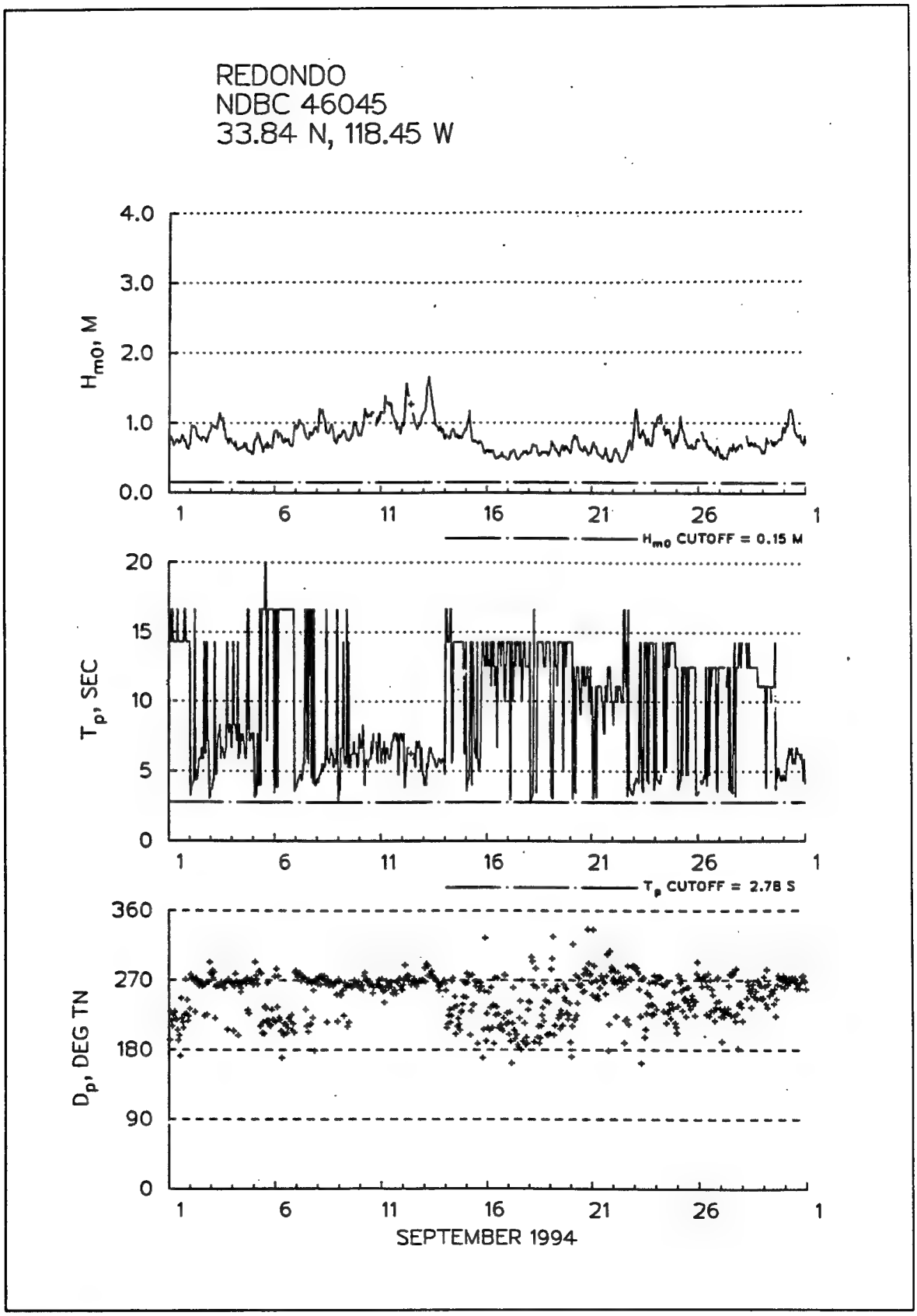

Figure L8. Redondo (NDBC 46045), September 1994

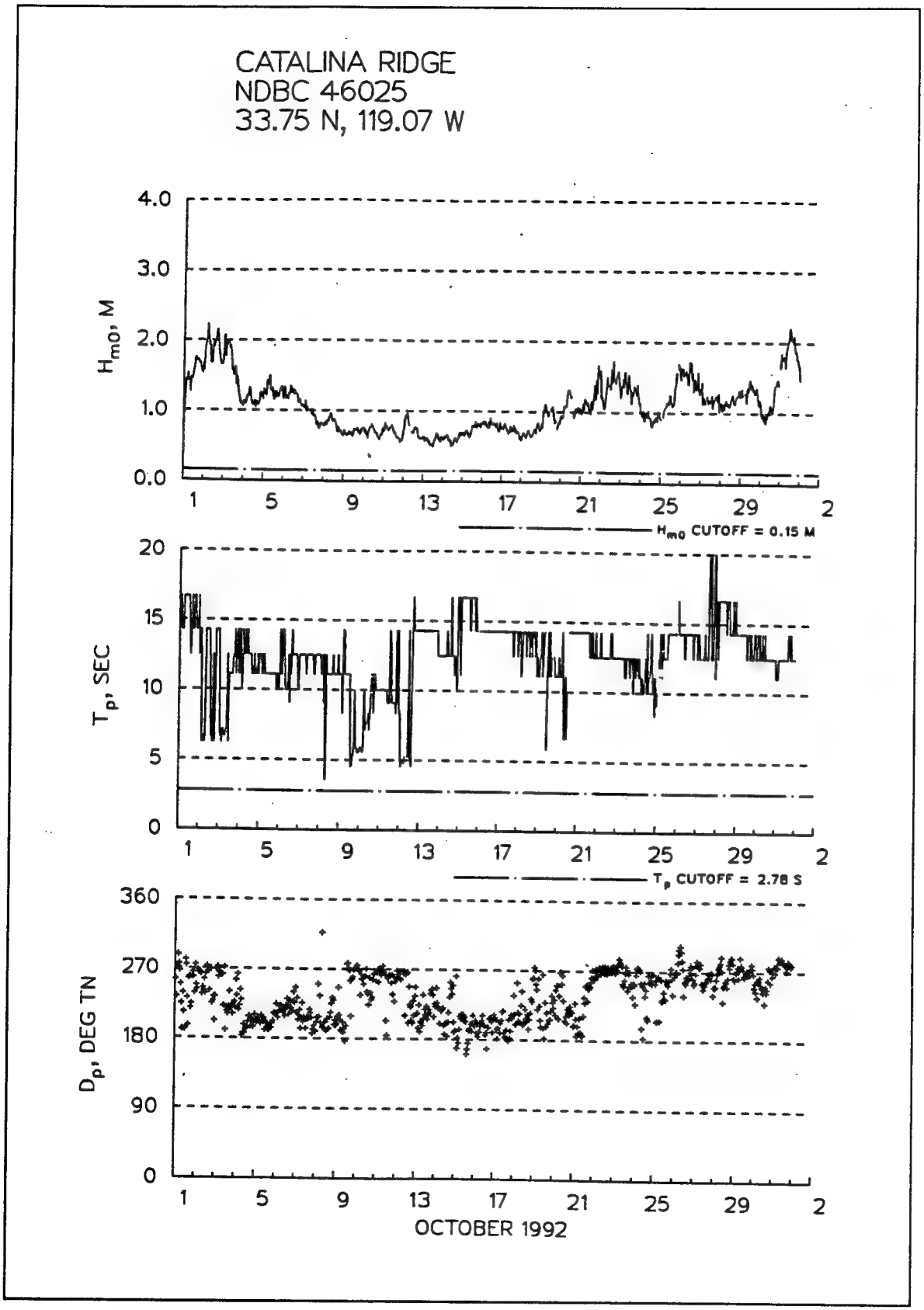

Figure L9. Catalina Ridge (NDBC 46025), October 1992

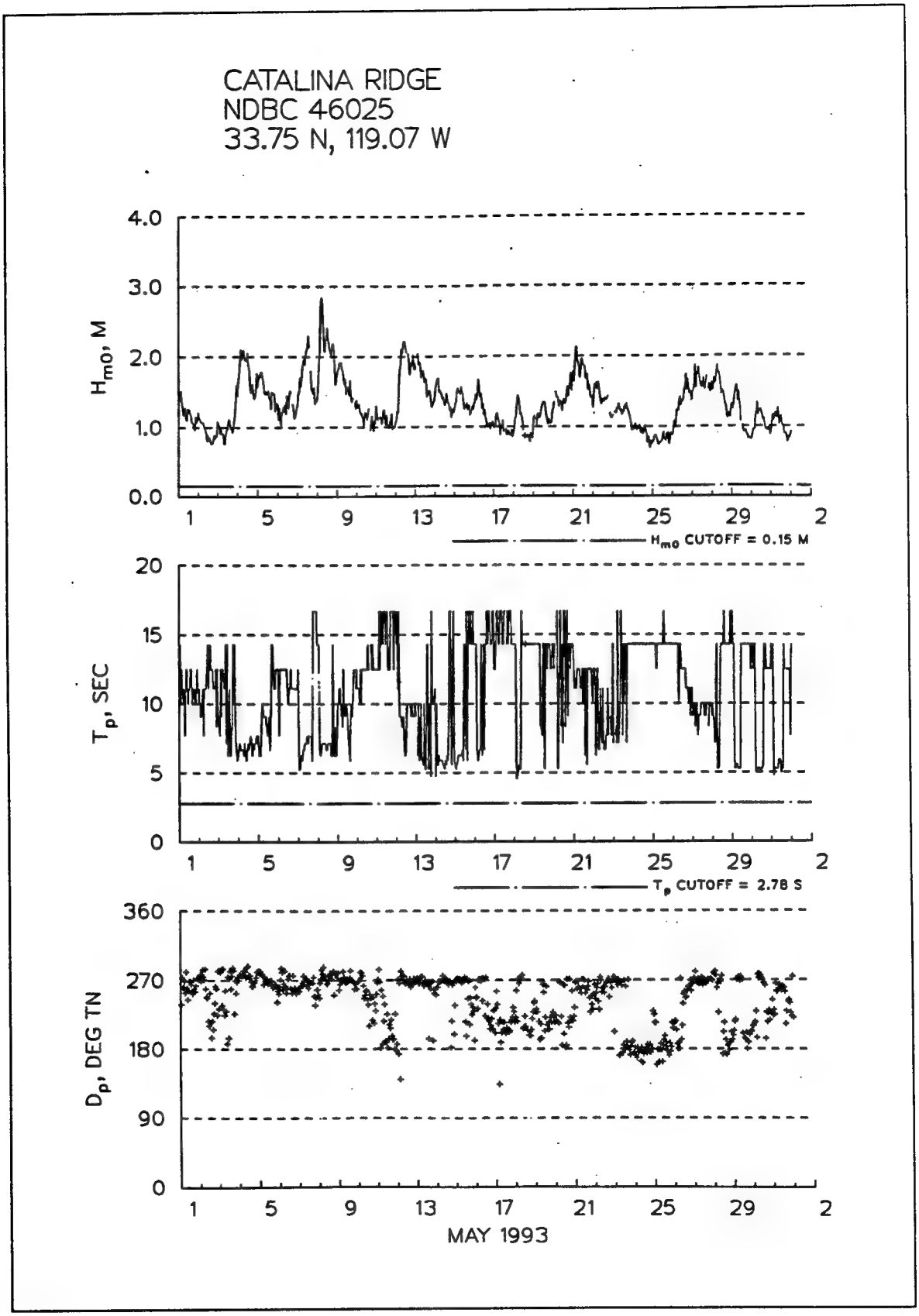

Figure L10. Catalina Ridge (NDBC 46025), May 1993

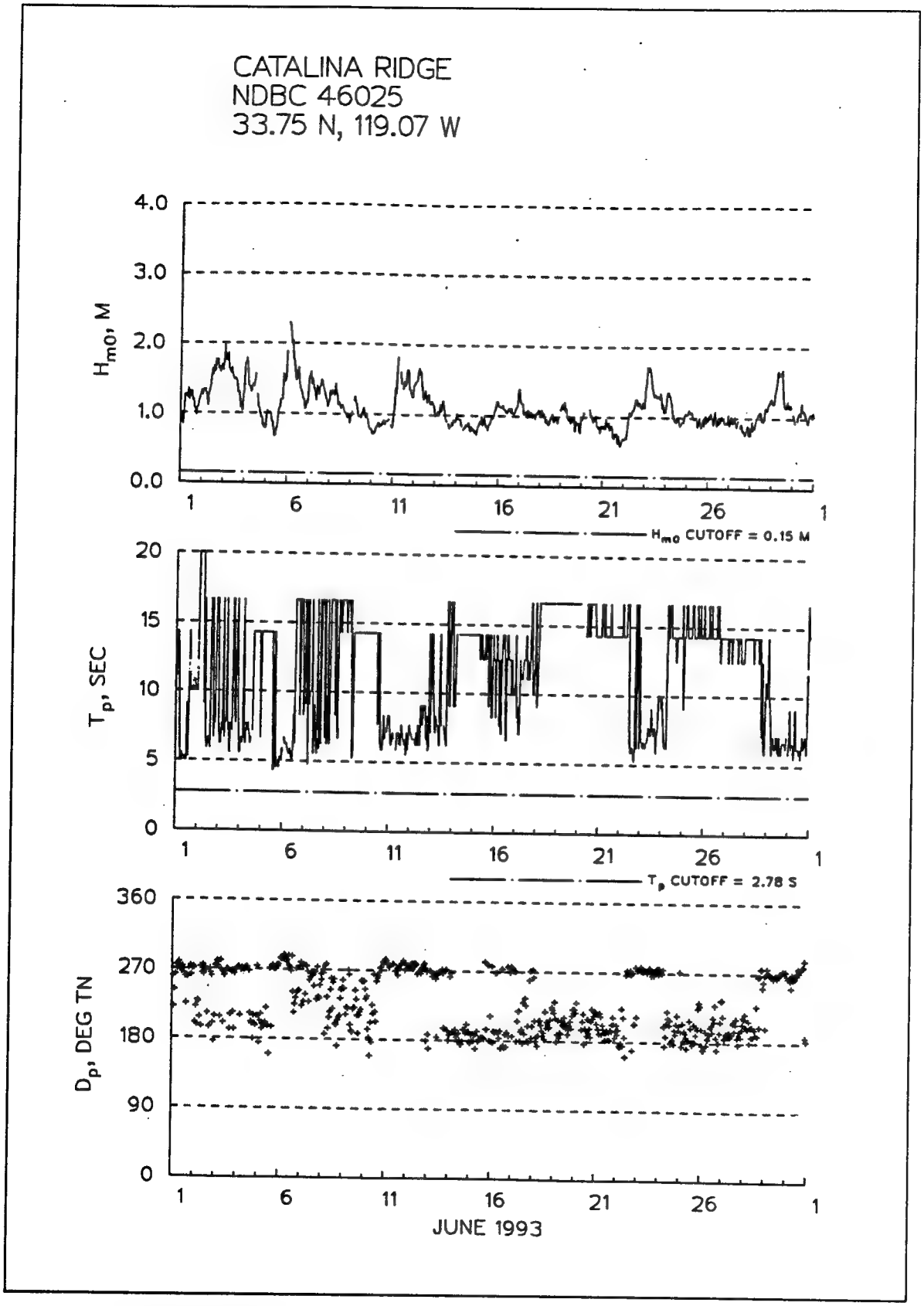

Figure L11. Catalina Ridge (NDBC 46025), June 1993

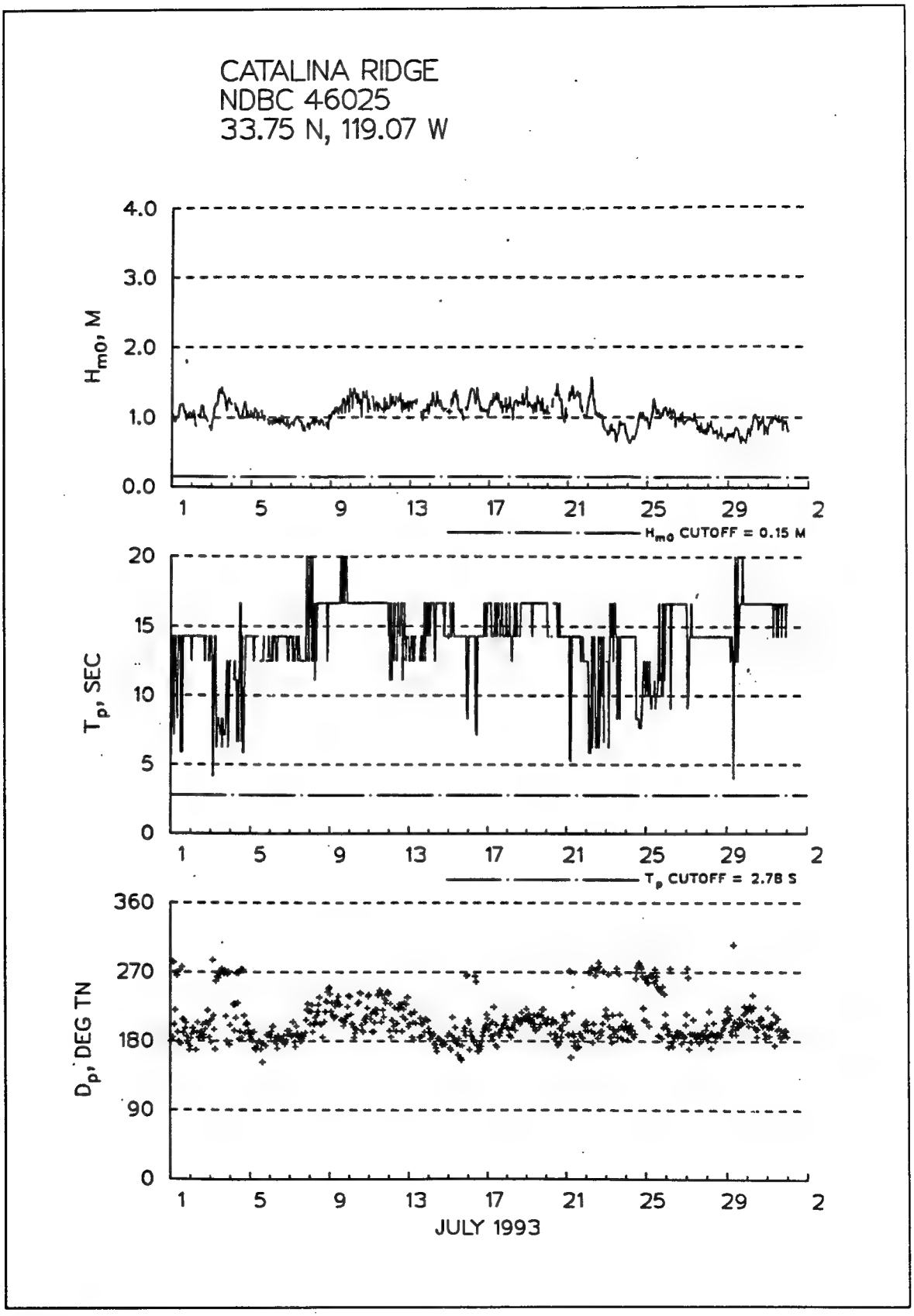

Figure L12. Catalina Ridge (NDBC 46025), July 1993

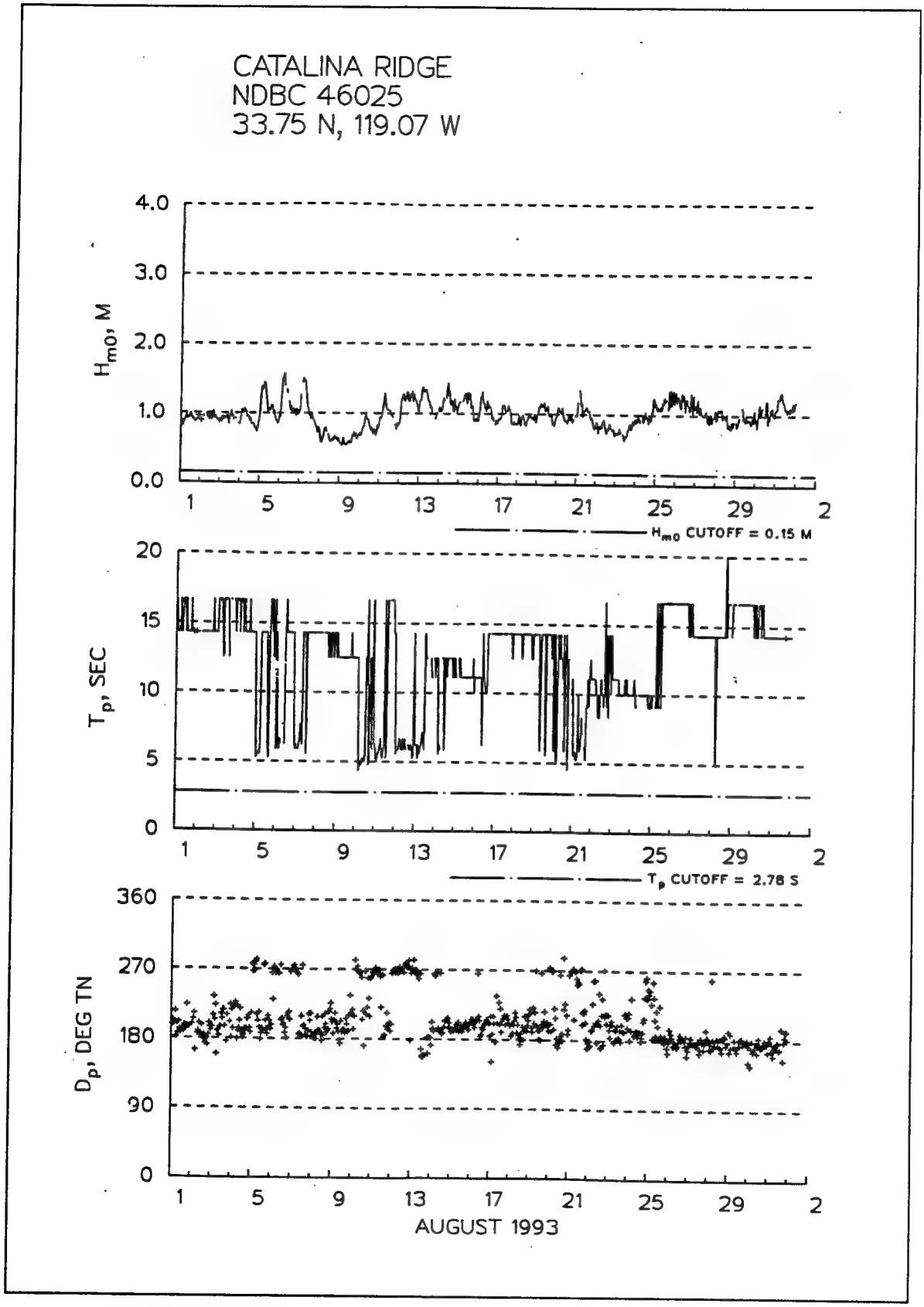

Figure L13. Catalina Ridge (NDBC 46025), August 1993

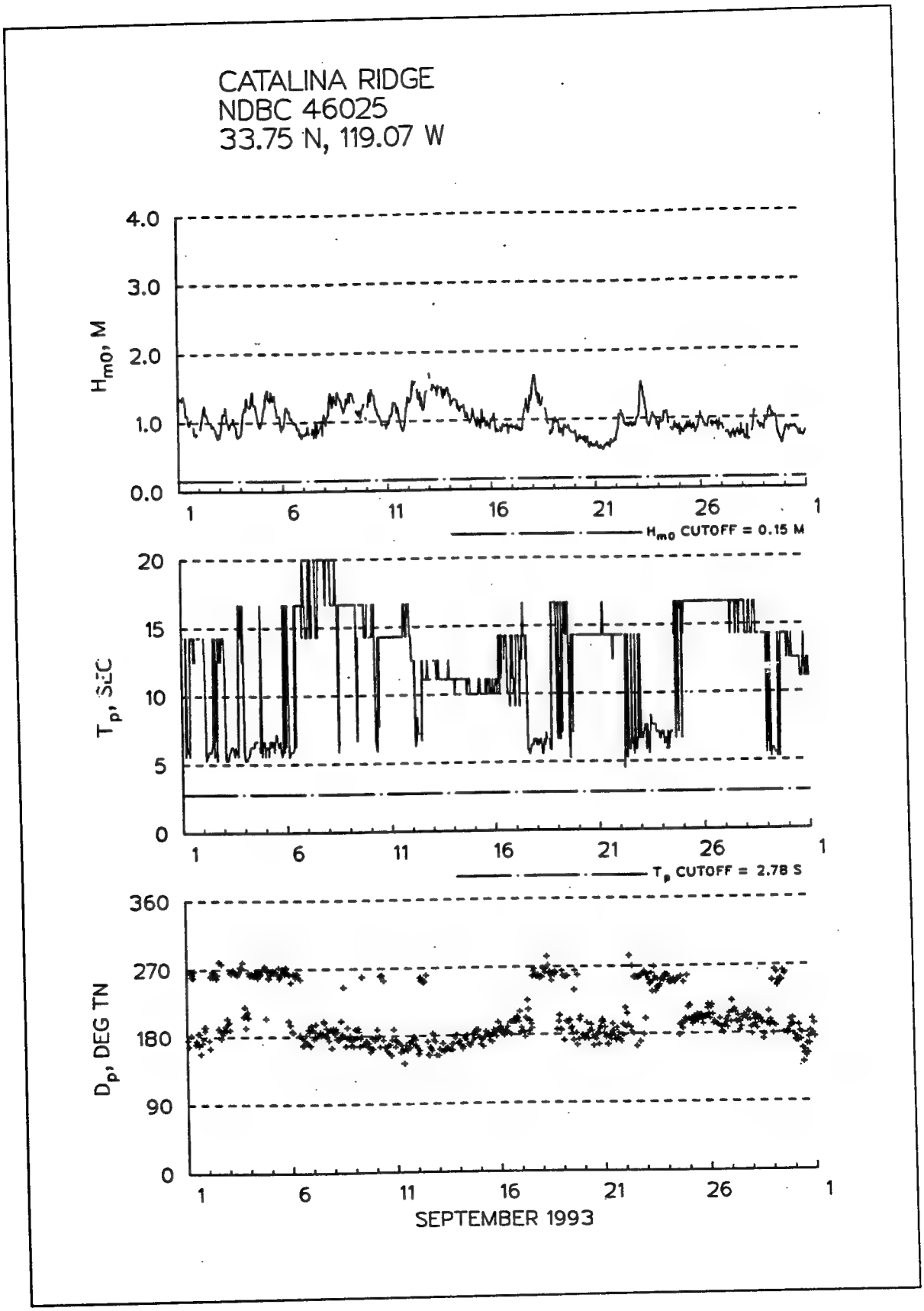

Figure L14. Catalina Ridge (NDBC 46025), September 1993

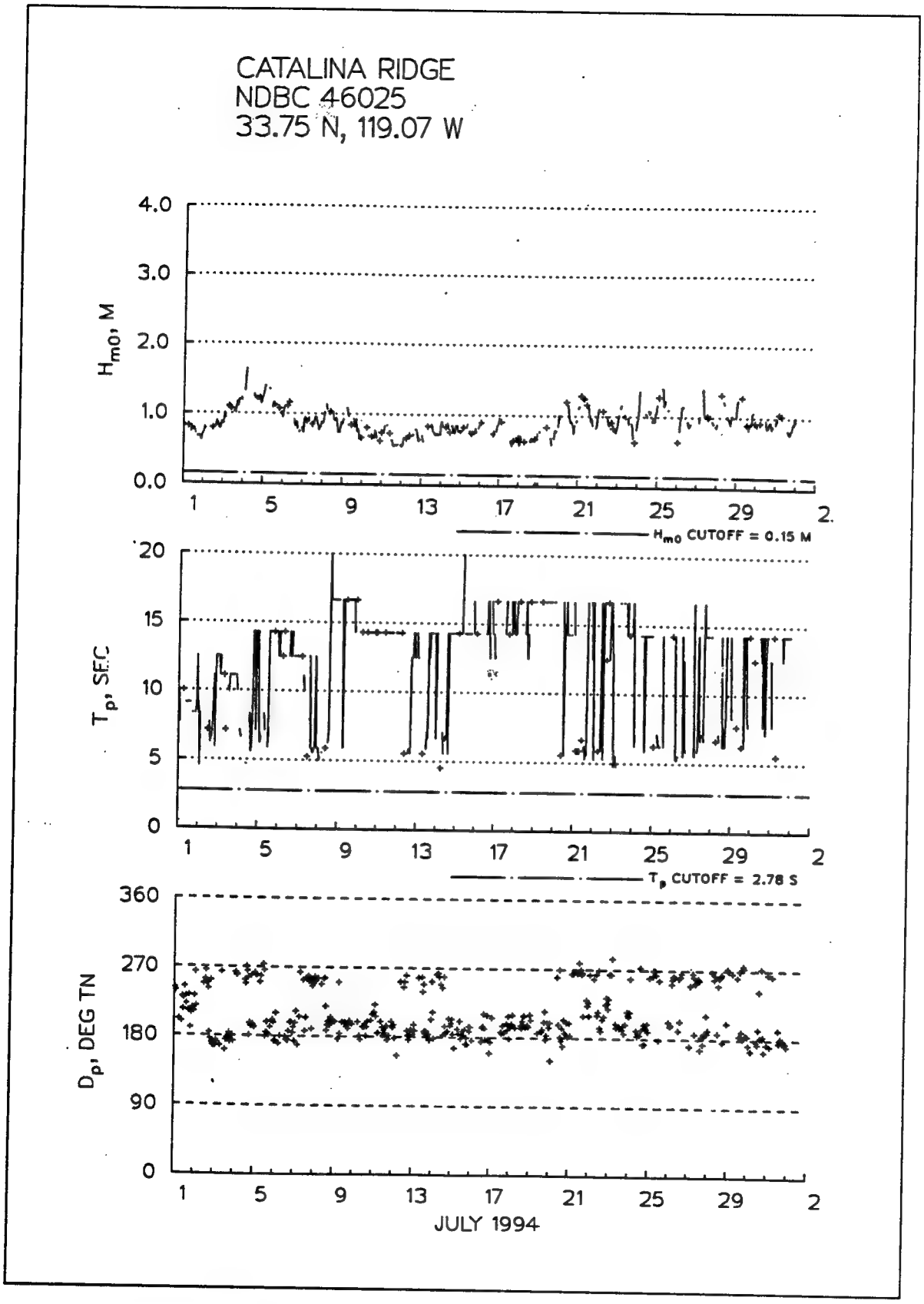

Figure L15. Catalina Ridge (NDBC 46025), July 1994

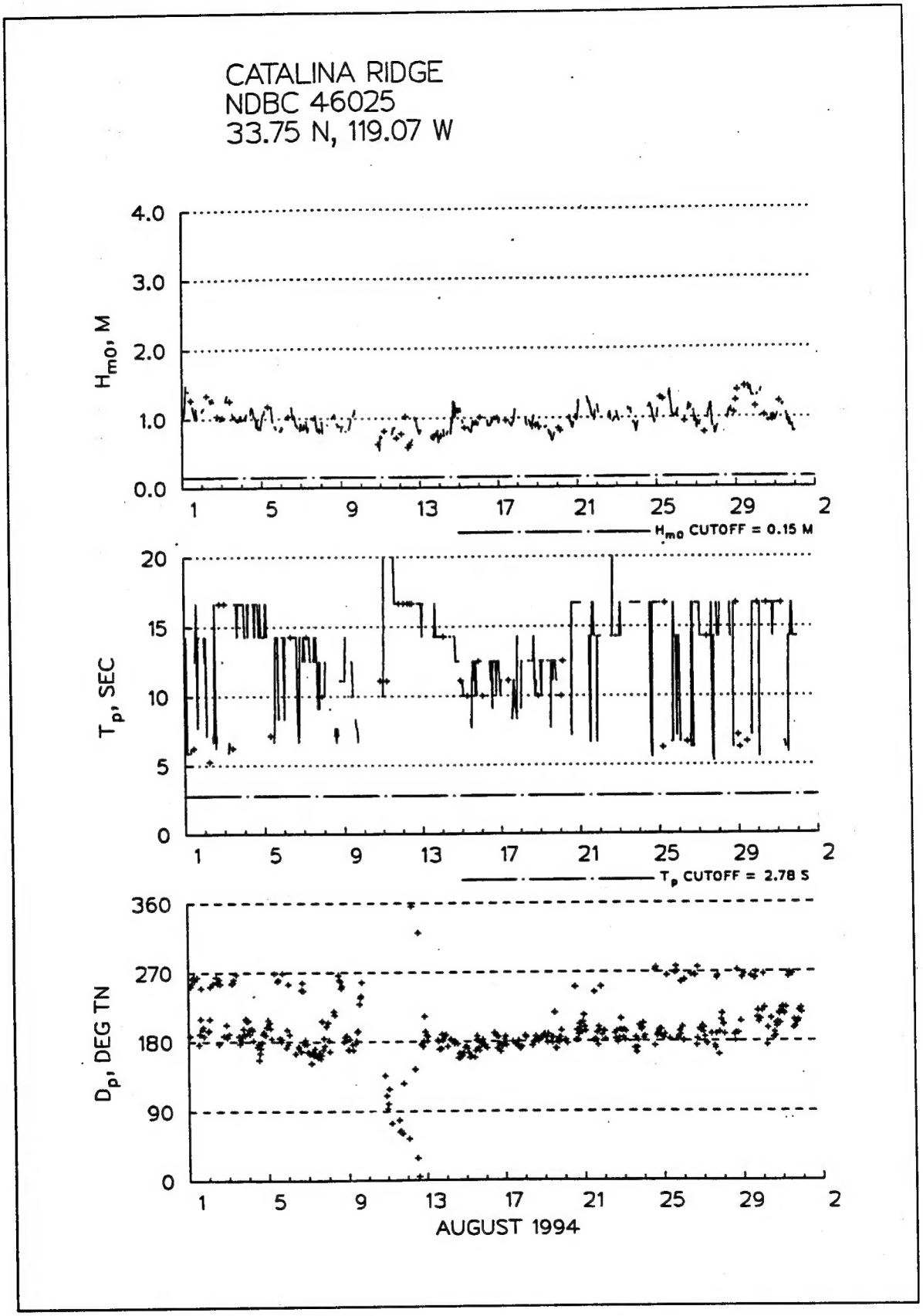

Figure L16. Catalina Ridge (NDBC 46025), August 1994

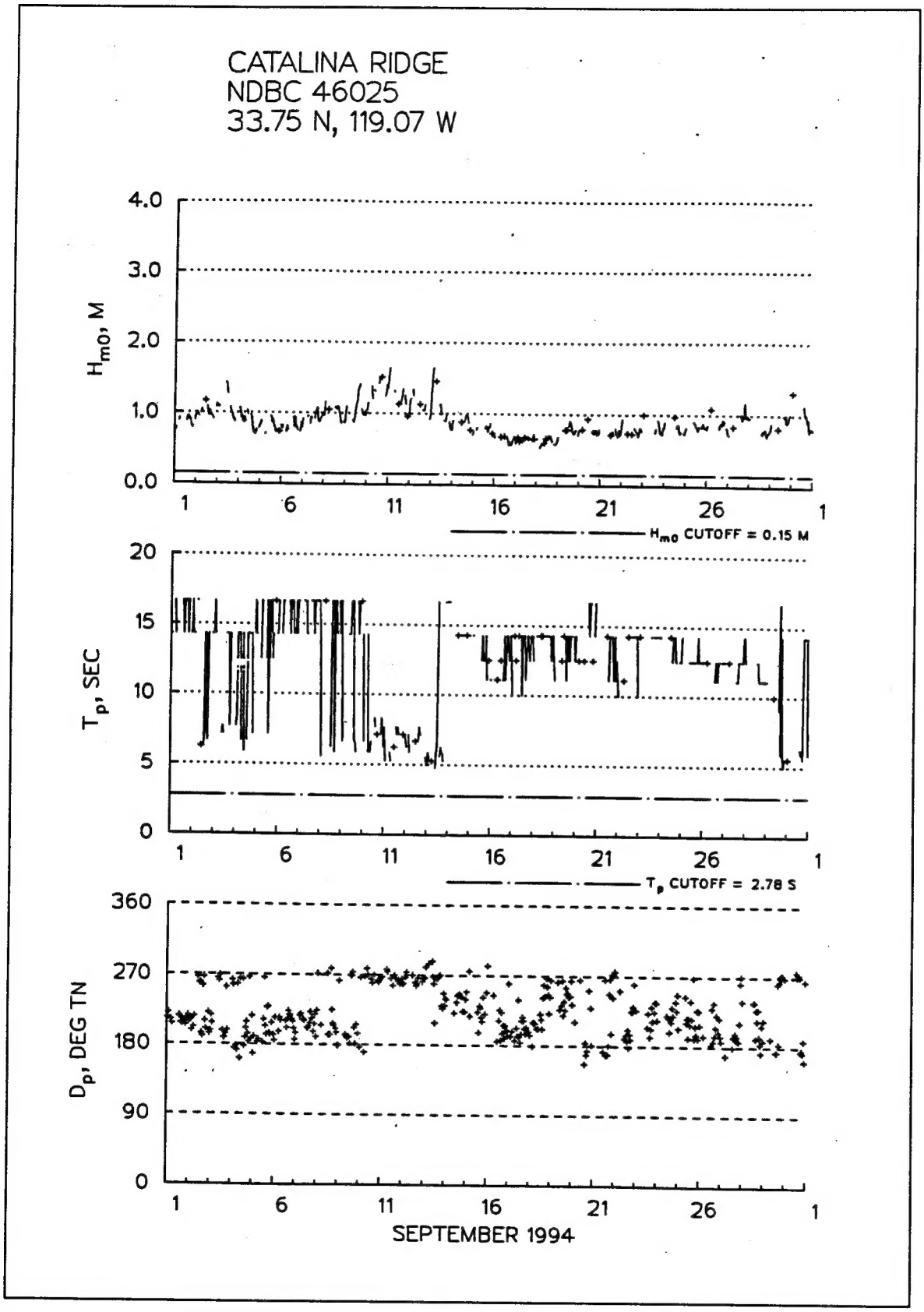

Figure L17. Catalina Ridge (NDBC 46025), September 1994

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This report summarizes field wave data acquired at Redondo Beach breakwater, CA, during a 2-year period beginning October 1992 and ending in June 1994. The purpose of this study was to provide actual field data to evaluate output from a numerical model which predicts wave propagating through a coastal region of irregular bathymetry. This report contains brief descriptions of the monitoring effort and equipment and provides collected wave information in graphic and tabular form. Statistical analysis of wave data will be provided in a future report.

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